



INDIAN AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI.

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29132/36

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE, TRINIDAD & TOBAGO.

Issued by the Department and Board of Agriculture



29132/36

Editorial Committee.

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Editor :

W. G. Freeman.

TRINIDAD.

PRINTED AT THE GOVERNMENT PRINTING OFFICE, PORT-OF-SPAIN.

Price : Six Pence.

Circulars of the Department of Agriculture.

- No. *1—The use of Bordeaux Mixture.
- „ *2—Carpenter Bird and Cacao.
- „ 3—Courses of Reading and Examination in Practical Agriculture.
- „ 4—Strongylus Parasites in Cattle.
- „ *5—On Spraying Froghoppers.
- „ *6—The Froghopper Fungus and its Practical Application.
- „ 7—The Improvement of Sea Island Cotton by Hybridization.
- „ *8—Results obtained in the Study of the Froghopper during the Wet Season of 1910.
- „ *9—The Palm Weevil as a Sugar Cane Pest.
- „ 10—Special Cotton Seed.
- „ *11—Short Hints on Cacao Cultivation.
- „ 12—Notes in connection with the good Cultivation of Cacao.
- „ 13—Tobacco Cultivation in Tobago.
- „ 14—Rainfall Returns for 9 months ending September, 1912.
- „ 15— „ „ 3 months „ March, 1913.
- „ 16— „ „ 3 months „ June, 1913.
- „ 17—Nursery Stock Price List.
- „ 18—Agricultural Credit Societies Ordinance, Trinidad and Tobago.

SPECIAL CIRCULARS, Froghoppers Nos. 3 to 7 and 9—by Mr. J. O. Kershaw.
Nos. 8 and 10 by Mr. P. L. Guppy.

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(ISSUED BY THE DEPARTMENT OF AGRICULTURE.)

* The Cacao Thrips.

- No. 1—Life History and Control of the Cacao Beetle.
- „ 2—Report of the Mycologist for the year ending March 31, 1911
Part I, containing reports of the Entomologist, Assistant Entomologist and Secretary.
- „ 3—Insect Notes for the year 1910-11. Miscellaneous notes.
- „ 4—Report of the Mycologist for the year 1910-11. Part II.
- „ 5—Preliminary Notes on some insects affecting the Coconut Palm.
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- „ *8—The Green Muscardine Fungus and its use in Cane Fields.
- „ 9—The Sugar Cane Froghopper.
- „ 10—The Surinam Witch-Broom Disease of Cacao.
- „ 11—The Froghopper Egg Parasite and its Colonization in Cane Fields.
- „ 12—The Mongoose in Trinidad and methods of destroying it.
- „ 13—Locusts and methods of destroying them.

Copies of both series of Circulars may be had upon application to the Director of the Department of Agriculture excepting those marked with an asterisk *, which are out of print.

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under Ordinance No. 80, 1915.

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Scarborough, Tobago.

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Special Appointment.

C. B. WILLIAMS, M.A., (Camb.) F.E.S.

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THIS Library can be consulted at the Head Office of the Department, St. Clair Experiment Station. It contains standard works on General Agriculture, Horticulture, Botany, etc., and books and periodicals dealing with Cacao, Sugar, Coconuts, Rubber, Cotton, Tobacco, and other crops

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Department of Agriculture.

GOVERNMENT STUD ANIMALS.

THE following are the arrangements for June with regard to Stud animals of the Government Farms in Trinidad and Tobago.

Stallions.

<i>Name.</i>	<i>Class.</i>	<i>Where standing for Service.</i>	<i>Fee.</i>	<i>Grooms' Fee.</i>
MARAT ...	Thorough-bred	Govt. Farm Tobago ...	\$ 4.80	60c.
QUICKMATCH.	Thorough-bred	Govt. Farm Trinidad...	10.00	60c.
SIR HORRY...	Thorough-bred Hackney..	Govt. Farm ..	5.00	60c.
SIR HORACE..	Half-bred Hackney	Govt. Farm ..	5.00	60c.
RILLINGTON SPARTAN..	Cleveland Bay..	Govt. Farm ..	5.00	60c.

Jack Donkeys.

McNarch	American Donkey	Palmiste Estate	5.00	60c.
...	Do. do.	Govt. Farm, Tobago...	5.00	60c.

Bulls.

A.—AT GOVERNMENT FARMS.

TRINIDAD.

TOBAGO.

<i>Class.</i>	<i>Fee.</i>	<i>Class.</i>	<i>Fee.</i>
1 pure-bred Shorthorn ...	2.40c.	1 Half-bred Holstein	\$1.00
1 " Holstein ...	2.40c.	1 Pure-bred Zebu	1.00
2 " Zebu ...	1.20c.		
2 " Jersey ...	2.40c.		
2 half-bred Red Poll ...	1.20c.	Ruby—Half-Bred Red Poll...	1.00

B.—AT PUBLIC PASTURES.

<i>Place.</i>	<i>Class.</i>
Queen's Park Savannah	2 Half-bred Shorthorn; 1 Half-bred Guernsey.
Mucurapo Pasture:	1 Pure-bred Shorthorn. 1 Half-bred Holstein.
St. Augustine Estate:	1 Half-bred Holstein;
River Estate:	1 Half-bred Zebu. 1 Half-bred Shorthorn.
San Fernando:	1 Pure-bred Holstein;
Arima:	1 Half-bred Jersey. 1 Pure-bred Zebu.

Pigs.

AT GOVERNMENT FARM, TRINIDAD.

White Yorkshire, Berkshire, Poland China	Tamworth	Fee \$1.00 :
Attendant's Fee 25c.		

AT GOVERNMENT FARM, TOBAGO.

Berkshire	Fee 50c.
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POULTRY.

GOVERNMENT FARM, TRINIDAD.

Eggs of Barred Plymouth Rocks, Black Minorcas, Brahmas (light), Rhode Island Reds, White Leghorns	...	\$1.00 per doz.
Great Kind Pigeons	...	40c. and 60c. per pair.

GOVERNMENT FARM, TOBAGO.

Eggs of Plymouth Rocks, Black Minorcas, Rhode Island Reds	48c. per doz.
Also Cocks and Pullets of Plymouth Rocks and Rhode Island Reds.	

Department of Agriculture.

ORDERS FOR PLANTING SEASON, 1918.

To prevent disappointment, orders for Cacao, Coffee and Limes needed for the planting season of 1918, should be sent in at once addressed to the Curator, St. Clair Experiment Station, or to the Officer in Charge Botanic Station, Tobago.

Special quotations at St. Clair for Cacao, Coffee and Limes grown from selected seeds are as follows :—

Plants purchased in lots of 1 to 1,000 plants	} Delivered at Nurseries
8 cents per plant.	
Plants purchased in lots of several thousands	} uncrated.
2½ cents per plant.	
Plants purchased in lots up to 100 at 4 cents per plant.	} Delivered at Railway Station, Port-of-Spain or Queen's Wharf, securely packed in open crates.
Plants purchased in lots up to 1,000 at \$3.50 per 100.	
Plants purchased in lots of several thousands at \$38.00 per 1,000.	

Tobago prices on application at the Botanic Station, Scarborough.

Budded Avocados select varieties at 12 cents, Budded Oranges at 24 cents and Grafted Mangos at 24 cents should also be booked at once.

Budded Cacao 12 cents each or in lots of over 100 at 8 cents.

Lime from beds 1½ cents per plant for lots over 100.

A select stock is also kept of other fruit, ornamental and flowering trees, palms, etc., a list of which can be obtained on application. Large orders must be booked six months previous to the date when the plants are required as large supplies are not kept on hand for casual demands.

NURSERY STOCK LIST.

The new edition of this list giving prices of plants usually stocked at St. Clair Experiment Station can be had on application.

Board of Agriculture.

PEST GANG.

The Board of Agriculture has in its employ a man who is trained in spraying, cutting out canker and cacao beetles, and other sanitary work. This man is available to teach such work to estate labourers. The wages of the man, while actually employed by the estate, are to be paid by the estate, but travelling expenses will be paid by the Board. Materials used in spraying will be supplied at cost price, and where possible, spray pumps will be lent.

From September to November is the time for spraying cacao trees for the prevention of thrips and black rot; and early in the dry season for the Algal disease and die back.

The Board of Agriculture has on hand a supply of bluestone, which is sold to planters at cost price plus 10 per cent., also nicotine sulphate, the best insecticide for thrips, which is sold at \$10 per gallon.

Further information in regard to Pest Gang, cost of spraying, etc., and applications for bluestone and nicotine sulphate should be made to

THE HONORARY SECRETARY,
Board of Agriculture,
Port-of-Spain.

THE BULLETIN.

The Bulletin is issued quarterly, price sixpence per number, or two shillings per annum post free in the Colony. To other subscribers postage extra.

Subscriptions should be remitted by Postal Order, to the Acting Director of Agriculture, St. Clair Experiment Station. If so addressed they will come post free from within the Colony.

OUR LOCAL FOODS,

Their Production and Use.

BY

W. G. FREEMAN, B.Sc., &c., and R. O. WILLIAMS.

Price 8d.

This pamphlet gives directions for the cultivation of the chief local food crops and treatment of pests; also recipes for the use of corn meal, sweet potatoes, dasheens, tannias, yams, cassava products, &c.; the preparation of meals and their use as flour substitutes; preparation of coconut butter, &c.

To be obtained from the Department or from Messrs. Muir, Marshall, or Davidson & Todd.

BULLETIN
OF THE
DEPARTMENT OF AGRICULTURE
Trinidad and Tobago.

PART 1.]	1918.	[VOL. XVII.
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The Profitable Cultivation of Ground Provisions.—Now that so much attention is being given to the production of ground provisions it is important to urge the advantages of intensive cultivation. Too many cultivators work a large area in poor fashion and get correspondingly poor returns, whereas, in many cases, from the same labour and expenditure on a smaller area larger profits would be obtained. The following are examples of results actually obtained during the past season:—

Mr. A. B. Carr, Caparo—On one-eighth of an acre (a village lot), planted 250 lb. of yams in well prepared trenches and reaped 5,080 lb.

Cost of cultivation	...	...	...	\$12.00
Value of yams for planting	...	...	...	7.50
Total Expenditure	...	...	...	\$ 19.50
Value of Crop—5,080 lb. at 8c. per lb.	...	...	...	150.90
Profit on 1-8 acre	...	...	...	\$131.40

Mr. W. S. E. Barnardo, Tamana:—With an expenditure of \$18.70 on cultivation the following crop has been obtained:—

Yams (306 holes)	...	8,690 lb. at 2c. per lb.	...	\$ 73.80
Chinese tannias	...	200 lb. „ 1c. „	...	2.00
Cush-cush	...	100 lb. „ 8c. „	...	3.00
Pumpkins	...	165 lb. „ 1c. „	...	1.65
Nut eddoes	...	600 lb. „ 1c. „	...	6.00
Value of crop	...	...	...	\$ 86.45
Expenditure	...	...	...	18.70
Profit	...	...	...	\$ 67.75

Mr. Barnardo states that the yam crop was poor compared with that of 1916 due to excessive rain in May and June. The cush-cush failed for the same reason.

Mr. L. Scheult, River Estate, Department of Agriculture.—Mainly as catch crops in establishing permanent cultivation of the following plants: 500 limes, 1,000 mahogany, 4,000 cedar, 8,000 coffee.

Yams	...	19,000 lb. at 2½c. to 8c. per lb.	...	\$ 540.00
Tannias	...	72,000 lb. at 2c. per lb.	...	1,440.00
Corn	...	100 barrels at \$1.75 per brl.	...	175.00
Cassava, Peas, Ochroes, Pumpkins, Cucumbers	...	...	...	100.00
Total returns	...	...	...	\$2,255.00
Expenditure	...	...	...	1,100.00
Profit	...	...	...	\$1,155.00

The expenditure includes cost of planting and cultivation of the permanent crops, but not the cost of the plants themselves. It should be noted too that the land on which these crops were raised was not burnt, but all the felled material was allowed to lie on the ground. On steep hill sides any fallen logs are useful in preventing wash.

Directions for the cultivation of ground provisions are given in the recently issued pamphlet; "Our Local Foods, their production and use," price 8d.

Local Food Products at the Agricultural Exhibition, 1918.
—The increased interest taken in local food products was very marked at the Agricultural Exhibition of March 1918. There were very good exhibits of ground provisions—yams, sweet potatoes, dasheen, tannias, cassava, cush-cush, etc., not only in the ordinary classes, but throughout the District Agricultural Societies exhibits, indicating the attention which is being given to these products in the Colony. It was encouraging to find that the propaganda work of the Department of Agriculture in urging on the small cultivator and others the possibilities of storing surplus supplies of perishable products, by converting them into chips and meal, and the use of the latter as flour substitutes, was bearing fruit. Two years ago the only meals, etc., displayed were those made at the Botanic Station Tobago, by Messrs. H. Meaden (Officer in Charge) and J. Blackman (Foreman). Last year, Mr. A. B. Carr also showed an interesting set of meals, etc., and it should be noted that he has for some years successfully stored dasheen in the form of chips. This year, in addition to the Department's more extensive display, there were numerous exhibits from many parts of the Colony.

The *Tacarigua* Society showed bread and cakes made of one part flour and two parts corn meal; seven sets of meals, about twenty varieties of beans and peas, and a large collection of yams of different varieties (2nd prize for Horn yam) tannias (2nd prize) dasheen, sweet potatoes, cush-cush (1st prize), rice, and corn.

The *Naparima* Society secured 1st prize for sweet potatoes, 2nd prize for cassava, and had also a good general exhibit of ground provisions, rice and pulses. Cassava cakes and meals were well represented.

The *Savana Grande* Society secured 1st prize for Chinese yams, and 2nd prize for cassava. There were three sets of meals one of which gained an extra prize. Breads were shown made of Lisbon yam, tous-les-mois, and plantain meals, all in the proportion of three of the meal to one of flour; and other breads made of flour with bitter cassava, sweet cassava, moko banana, Gros Michel banana and red banana meals; also cassava cakes.

Fyzabad Society won 1st prize for dasheen, and had a good rice exhibit. Chips and meals of dasheen, cassava, banana, also corn meal and rice flour were shown, and the East Indian rôti made of banana and cassava meals in the proportion of three parts of either to one of flour.

Arima Society secured 1st prize for tannias and corn and 2nd prize for cush-cush, but made no special display of uses for ground provisions.

Sangre Grande Society had a moderate exhibit of ground provisions also cassava, starch, farine, and cakes, and locally prepared lard.

The *Tobago* (Windward) Society won 1st prize for a collection of yams, and 2nd prize for sweet potatoes. Of special interest was the Waraque tannia—known locally as “yellow belly”—which came to notice at the Roxburgh Agricultural Exhibition earlier this year. It develops an enormous central stem, more or less cylindrical, reaching about 5 to 6 feet in height and a weight of over 100 lb. One specimen was 120 lb. at two and a half years. It thrives in moist land and is well worthy of cultivation, if only as a stock food. The corn shown—as usual from Tobago—was rather poor, indicating that none or very little care is given to selecting good cobs for planting. Some ten varieties of pulse were shown. Dried chips and meals were well represented by five different sets—including banana (moko, silk fig, Gros Michel, sucrier), plantain, yam, sweet potato, tannia, dasheen, arrowroot, tous-les-mois, cassava, and breadfruit; also white and yellow corn meal.

The *Boys' Reformatory*, Diego Martin, as might be expected from the excellent work done there recently in the use of local foods, (*see Bulletin* XVI, 1917, p. 175) had a good exhibit including breads of equal parts of flour and sweet potato, banana, and tannia; meals from tannia, yam, sweet potato, cassava, breadfruit, banana, ground provisions and English potatoes. It is found that the use of meals, such as sweet potato, in the preparation of soup is much more economical than the use of the raw vegetables where a good thick soup is desired.

General Exhibits: Amongst the general exhibits were another eight sets of meals, and more breads of various composition. The two loaves which won 1st prize were made of flour two parts and yam meal one part; and flour three parts and banana meal one part. Other loaves shown were made of equal parts of flour and yam meal; flour two parts and cassava one; flour two parts and dasheen meal one; flour two parts breadfruit one part; equal parts of flour and red banana meal. In this class there was also a specimen of rôtî of equal parts of banana (silk fig) meal and flour.

Cane Farmers' Competition, 1918.—Attention is directed to the Cane Farmers' Competition which will be held this year in Naparima (see p. 49). The area has been divided into two districts, and two sets of prizes of a total value of \$280 are offered. As in the case of previous competitions the necessary funds are provided by the Board of Agriculture and the work will be under the charge of the resident Agricultural Adviser, Mr. C. M. Roach.

Storage for Local Food Crops.—In addition to the two concrete corn bins erected last year the Government has erected at the Government Farm, St. Joseph, two concrete silos to hold about 150,000 lb. each of black eye peas, corn or other perishable crop. These will be available this year for food crops and with the return to normal conditions be used as silos. An existing building at the Farm has also been altered slightly, so that fumigation can be done in it, and this it is estimated will hold about another 200,000 lb. of peas, &c. The total storage room will amount to about 650,000 lb. (See also p. 17.)

LIMES.

REPORT ON A VISIT TO THE GOVERNMENT
CO-OPERATIVE LIME FACTORY AT ST. LUCIA.

BY HENRY MEADEN,

Manager Government Farm, and Officer in Charge
Botanic Station, Tobago.

THE ACTING DIRECTOR OF AGRICULTURE.

I have the honour to report that acting on instructions received from you, I visited Saint Lucia from November 28 to December 11. 1917 for the purpose of studying the Lime Industry as worked on co-operative lines and also the running of the Factory Plant. I am greatly indebted to Mr. A. J. Brooks, Agricultural Superintendent of St. Lucia, for the very complete information in connection with the lime industry, factory requisites, system of buying the limes and juice and selling the manufactured article.

The Lime factory was started for concentrating juice and distilling oil in November, 1913, at a cost of £550 and comprised: 1 10 h.p. multitubular boiler; 1 donkey feed pump for boiler; 1 "Siddall" mill for hand power; 1 "Ellis" 3 h.p. oil engine; 1 "Ideal" condenser; 1 "Gould's" rotary pump; 1 wooden still; 2 wooden juice vats with copper steam coils; 1 wooden juice store vat; 4 wooden subsiding vats and various small accessories.

The building is an iron-framed wooden building with concrete floor, 40 ft. x 36 ft. x 12 ft. high, taken over from the War Department at small cost.

A good water supply is obtained from town pipes.

In 1916-17 owing to rapid development in the lime industry, it was found necessary to enlarge the factory considerably, when the following additions were made to the plant—1 "Crossley oil engine, 5, H.P.; 1 "English" boiler 25, H.P.; 1 bronze rotary pump; 1 wooden still, 300 gallons, with copper fittings; 1 storage vat of 500 gallons; and 1 boiling vat of 500 gallons, both made of wallaba staves.

With two extensions to the building 35 ft. x 15 ft., one for the 25 H.P. Boiler and the other for storing the finished article until ready for shipment.

To start the factory a loan of £550, from Government was obtained at 10 per cent. for ten years; and to extend the plant, etc., a further loan of £1,000, was granted at 5 per cent., for twenty years. It is not at all unlikely that further extension to the plant will soon be required judging from the busy appearance of lime vendors paying daily visits to the factory with loads of limes.

The cost of the Onderneeming Factory, Demerara, built in 1916 on similar lines to the St. Lucia Factory, in its initial stage amounted to £645, and I am informed by Mr. Brooks that possibly 30 per cent. or more would now have to be added on account of increased prices due to the war.

The cost of a suitable building, machinery plant and equipment including erection expenses would now cost close on £1,000 to start with and Mr. Brooks suggested to me that at least a crop of at least 1,000 barrels of limes should be forthcoming before starting the factory.

METHOD OF WORKING THE PLANT.

MILL.

A "Siddall" mill having three rollers (one grooved), two feet by one, and fitted with double gearing for hand or power driving is used. It is at the side of the building to allow the crushed lime skins from the mill to pass by gravity to a concrete box outside so that they are only handled once in being disposed of. This mill is capable of crushing ten barrels of limes per hour and is driven by a 5 h.p. "Crossley" oil engine.

STRAINERS, PUMP AND STORE VATS.

The juice and seeds pass from the mill into a wooden frame fitted with a coarse strainer of copper mesh over a wooden gutter, here a boy works the mass over the strainer with his hands and the juice runs through the strainer into the wooden gutter and by gravity to the pump tank where it again goes through a strainer of smaller mesh, from which it is lifted by a rotary force pump to the receiving vats (of 500 gallons capacity). The pump is driven by the same oil engine and has all parts in contact with the juice made of bronze; it is fitted with rubber suction and delivery hose and is placed in a position for dealing with mill or subsided juice, the latter reaching the pump tank by gravity. From the receiving vats the juice runs by gravity to the stills and thence to the subsidisers and after settling, to the pump tank to be pumped up to the concentrating vats.

CONCENTRATORS AND STILLS.

The receiving vats, still bodies and concentrators are constructed of wood—the staves of wallaba, and the bottoms of green heart—with iron bands so fitted as to allow of drawing in when the wood warps or shrinks.

The concentrators and stills are heated by steam coils of copper, 1½ inches external diameter, and of lengths to provide ten square feet of heating surface per hundred gallons of boiling capacity.

There are three concentrators of 500, 150, and 100 gallons capacity each, these concentrators are successfully operated with charges of juice equal to three-quarter of their full capacity.

Frothing in the boiling subsided juice in the concentrators is kept under control and to a uniform level by slight adjustment of the steam supply; as the boiling progresses the juice is skimmed from time to time until all the skum is removed by the use of a skimmer attached to a long wooden handle.

STILL WORK.

The two stills are capable of containing 100 and 140 gallons of juice, and are connected together both being coupled up to the same condenser.

The "Ideal" condenser works very satisfactorily.

The distillation of the essential oil contained in the juice is done by heating the juice in the still by steam: the essential oil comes over with the steam into the condenser; the distillate (water and oil) pours out of the condenser into a Florentine Flask which allows the water to flow away while retaining the oil. The yield of oil varies somewhat, but it is estimated that a hundred gallons of juice will yield about four lb. of essential oil.

SUBSIDING.

The hot distilled juice from the stills is run into two square vats made of wood (white pine) 500 gallons capacity; it is allowed to cool and the suspended particles to settle. The juice in the subsidiers is ready for concentration on the following day.

The subsidiers are fitted with brass taps two feet from the bottom. These allow the juice to run off clear of sediment or sludge. The sediment is let out of the subsidiers at the bottom by means of plugs and is placed in empty casks with equal portions of water, well stirred, and left to drip through wooden lattice bridges, fitted three-quarter way down in the casks. These bridges are covered with dried wire grass which holds up the sludge and allows the diluted juice to percolate through. This process is slow, but permits of very little waste of juice. The diluted juice obtained is passed on to the vats and is concentrated.

FACTORY BUSINESS.

The business of the factory is conducted on a co-operative basis. In determining the profits there are deducted from the amounts realized for the sale of produce the amounts paid for the purchase of limes and lime juice together with all expenses of working the factory and disposing of the produce, and, in addition a sum equivalent to 10 per cent. of the amount paid for the purchase of limes and lime juice. The remainder is regarded as gross profits to be divided; one-third being paid to the Government and two-thirds to the vendors. The latter is distributed to the vendors by way of bonus, in proportion to the amounts paid them for produce.

The sum equivalent to 10 per cent. of the value of the limes and lime juice purchased, together with the sum representing one-third of the profits mentioned above, is paid to the Government by way of interest and sinking fund in respect to the sum expended in erecting the factory.

The price paid for limes and lime juice is based on a scale of prices having a relation to the value of concentrated juice, and insuring a safety margin of profit to the factory. The vendor of fruit realizes his full value when he gets his bonus derived from the share of profits.

The following is the financial statement of the crop commencing May 1915 and ending March 1916 :—

RECEIPTS.

Net proceeds from sale of 68 casks concentrated lime juice (2,888½ gallons)	£1,266	1	10
Net proceeds from sale of 13 carboys distilled oil (1,062 lb.)	209	9	8
Total net receipts	£1,475	11	6

EXPENDITURE.

Paid for produce	694	18	8
Working expenses :—			
Labour, including salaries of management	£60	5	11
Fuel and Oil	56	17	8
Packages	19	10	6
Export duty and sale of produce	32	19	9
Contingencies	22	1	2
	191	14	7
Total	£	886	12 10

Other Charges :—

Contribution to general Revenue for Supervision	£30	0	0
10 per cent. Interest and Sinking Fund on Capital Account of £550	55	0	0
Depreciation Fund 5 per cent. on £550	27	10	0
Special Remuneration to Government Officers whose duties have been increased	80	0	0
	142	10	0

Total expenses	£1,029	2	10
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Total profits	£	446	8 8
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¼ Share of profits to go to Factory Reserve Fund	111	12	2
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¼ „ „ to be divided as bonus between vendors	£	334	16 6
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The produce dealt with during this period was 3,029 barrels of fruit, and 7,122 gallons of juice, representing a total crop of 3,920 barrels.

INITIAL COST OF FACTORY.

The following estimate was carefully prepared for the Demerara Factory by Messrs. Brooks and Bayley and should serve as a guide in the event of erecting a similar factory for Tobago.

(a.) One loco. type steam boiler, with all steam, water, and furnace fittings including steam-reducer, and having extra large fire-box for burning wood fuel...	\$	720.00
Freight and charges on above		40.00
(b.) Three steam traps and freight		24.00
(c.) One boiler feed pump with tank		144.00
Freight and charges on above		11.00
(d.) One Siddall Lime Crushing Mill for work either by hand or by power, Iron rollers 12 in. x 24 in. with fast and loose pulleys, extension frame, and shaft bearings for converting to power as required packed F.O.B., London		339.82
Freight on above... ..		28.80
(e.) One oil engine, Ellis 3 h.p. with Wico Magneto ..		147.94
All charges on above including freight		27.82
Extras for engine, 1 steel shaft, 1 box castings, 1 crate pulleys and oil, including freight and all charges		35.41
(f.) One condenser, as per specification		255.48
Freight on above... ..		14.04
(g.) One Goulds Rotary Pump. including suction and delivery hose, and fittings, total cost including freight and all charges		44.80
(h.) Four Wallaba Vats, as per specification from Sprotons (Ltd.), Demerara		100.00
(i.) Five subsidising Vats 68 2 in. 4 ft. x 2 ft. 4 in. x 5 ft. high		50.00
(j.) One Vat or tank for water supply		25.00
(k.) Rubber hose, brass connexions, pipes, brass cocks, strainers and accessories		100.00
(l.) Miscellaneous expenses, cost of erecting machinery freight on machinery, and unforeseen extras ..		400.00
(m.) Cost of building including concrete floor ..		450.00
(n.) Internal fittings		50.00
(o.) Possible increase in freights on account of war ..		92.89
Total	\$	3,100.00

Mr. Brooks informed me that item (e.) Oil Engine, Ellis 3 h.p. with Wico magneto proved a failure in the St. Lucia factory and has since been replaced by a 5 h.p. oil engine from Messrs. Crossley Bros., Ltd., Manchester, the cost of which amounted to £78 18 5 landed in St. Lucia. This engine works satisfactorily.

I attach plans of the St. Lucia factory, as working at present, these plans set forth in detail the arrangement of the plant, &c. (1)

PURCHASE OF LIMES AND JUICE.

The limes are bought from the people or estate owners at a price fixed at the beginning of the year or crop (3s. 9d. in 1917) and the juice at 6d. per gallon. The limes are bought in quantities from a quarter of a barrel up.

$\frac{1}{4}$ barrel	equal to	$1\frac{1}{2}$	Kerosene tins	at	3 9	per barrel	∴	11d.
$\frac{1}{2}$	"	"	1	"	box	"	"	1s. 8d.
$\frac{3}{4}$	"	"	$1\frac{1}{2}$	"	boxes	"	"	1s. 10d.
$\frac{1}{2}$	"	"	2	"	"	"	"	2s. 6d.
$\frac{3}{4}$	"	"	$2\frac{1}{2}$	"	"	"	"	2s. 9d.
1	"	"	3	"	"	"	"	3s. 9d.

Ecuelled Limes are not bought at the factory.

BOOKS KEPT AT THE FACTORY.

Specimen copy of each book kept, is attached. (1)

The system of issuing pass-books to the persons supplying produce to the factory is an excellent one as it enables the people to have a detailed account of their industry, and what is much more valuable, the pass-books serve as controllers on the vendors in case of theft.

The system is worked as follows:—Each family is given a pass-book with the amount of produce and amount paid them entered therein as they bring in their first lot of produce. The pass-book is brought to the factory with every subsequent lot of produce and entries are made accordingly.

The amount of produce and amount paid for it, is entered in the factory ledger to the account of vendor, and is open to inspection by any of the travelling Agricultural Inspectors, who take notes of the accounts in the ledger, and when on rounds of inspection can tell if the vendors are honest by comparing the entries with the number of trees in their possession. I am told, that this system has practically wiped out theft of fruit.

PRIVATE FACTORIES.

Mr. Brooks kindly arranged, and by courtesy of the Managers, for me to visit the Soufrière, and La Perle estates and factories, both estates are well developed and the factories up-to-date, the crushing plants and pumps are worked by water-power, the old sugar-crushers serving excellently for crushing the limes, all the vats were similarly constructed by those of the Government factory, and the juice concentrated by steam.

At both of these estates I had the opportunity of seeing and learning the method of "Ecuelling" limes, the process of extraction of the essential oil from the rind. There were some thirteen or fourteen women employed in performing this work and were earning from 1s. 6d. to 2s. per day, at the rate of 1d. per ounce (fluid) after the oil had been allowed to settle and filter.

The fruits are rolled under firm pressure from the hand on blunt brass pins arranged in a saucer-shaped copper dish fitted with a stout copper, hollow handle which collects the oil as extraction progresses. The women sit astride at one end of a kerosene box with the handle of the ecueiling pan fixed in a bracket at the other end of the box which keeps it firm, they then rub the fresh limes over the pins, many using the right and left hand rapidly in succession, they are nothing short of experts, when it is noticed, that, it takes from six to eight barrels of limes or more for them to earn 1s. 6d. to 2s. per day.

On one of these estates I had the opportunity of seeing a mixed cultivation. coconuts and limes, and it afforded a striking object-lesson of the utter unsuitability of trying to grow two plants of similar rooting habits. The coconut trees were thin-trunked and well over the lime trees, the latter were nearly all dead or gradually dying out, the soil conditions were good, but proved conclusively the undesirability of trying to intercrop limes with coconuts.

Mr. McGregor Peter kindly took me over his Corinth estate and factory, here I saw limes being ecuelled in the field, an excellent plan in fine weather, as the limes are gathered in the freshest possible stage thereby affording a better yield of oil; immediately after ecueiling, the limes are taken to the factory in carts and crushed, the juice is distilled settled and concentrated.

At this factory the complete plant was driven by steam from a powerful boiler.

The following copy of "Notice" to lime growers, St. Lucia, shows the conditions under which limes and lime juice is purchased:—

DEPARTMENT OF AGRICULTURE.

NOTICE.

The lime crop of 1916-17 having finished the Government Lime Juice Factory at Castries will be closed from Saturday, March 10, and re-opened for the purchase of limes and lime juice on Monday, April 2, 1917.

Until further notice limes and lime juice will be purchased from peasants at the Government Lime Juice Factory at the following rates:—

Sound ripe limes per barrel	8s. 9d.
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Pure lime juice testing 12 ounces or over per gallon	2s. 6d.
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No quantity less than a quarter of a barrel of sound ripe limes will be accepted and all green ones or unsound fruit will be rejected.

Any juice testing less than 12 ounces will not be accepted.

Any profits to be shared with vendors will be notified to them after the produce has been sold and the amount of the profits, if any, has been ascertained.

All previous notices with respect to the purchase of limes and lime juice at the Government Lime Juice Factory are hereby cancelled.

Notice.—The Agricultural Superintendent may refuse the whole or any portion of any produce presented at the Factory for sale.

(Sgd.) A.J.B.,
Ag. Superintendent.

PROFIT NOTICE.

The profits payable to vendors of produce of the Government Lime Juice Factory for the period ended February 27, 1915, will be made from September 14 to October 16 at the Government Lime Juice Factory.

Vendors applying for payment must bring with them the "Produce Vouchers" which were given to them at the time of their selling their produce at the Factory.

(Sgd.) A.J.B.,
Ag. Superintendent.

STAFF.

The factory is under the Agricultural Superintendent, and the following staff:—Manager at £72 per annum, Clerk at £36 per annum, Engine Driver at 2s. 8d. per day only when working.

One leading man, four men and a boy, at the usual daily wage.

TESTING THE LIME JUICE.

The raw juice is well stirred from which 10 C.C. is then taken and put into a 100 C.C. glass, take a little water to wash out the pipette to remove the acidity then fill the glass up to 100 C.C. with water, put into a beaker, then take 10 C.C. of the diluted juice and put into another beaker, again wash out the acidity from the pipette then add a couple of drops of the indicator, Phenolphthalein, wash out the pipette (as the Phenolphthalein affects the glass). Then take the alkaline solution and fill up measure glass to zero, then allow the alkaline solution to run into the beaker with the diluted juice and Phenolphthalein slowly until the solution becomes red, then read glass downwards and compare with the table.

*Alkaline Solution.**Citric Acid per gal.*

C.C.	10.0	...	...	...	...	11.2
	.1	...	...	...	...	11.3
	.2	...	...	...	...	11.4
	.3	...	...	...	...	11.5
	.4	...	...	...	...	11.6
	.5	...	...	...	...	11.7
	.6	...	...	...	...	11.8
	.7	...	...	...	...	11.9
	.8	...	...	...	...	12.0
	.9	...	...	...	...	12.2
	11.0	...	...	...	...	12.3
	.1	...	...	...	...	12.4
	.2	...	...	...	...	12.5
	.3	...	...	...	...	12.6
	.4	...	...	...	...	12.7
	.5	...	...	...	...	12.8
	.6	...	...	...	...	12.9
	.7	...	...	...	...	13.1
	.8	...	...	...	...	13.2
	.9	...	...	...	...	13.3
	12.0	...	...	...	...	13.4
	.1	...	...	...	...	13.5
	.2	...	...	...	...	13.6
	.3	...	...	...	...	13.7

Anything over 13.7 should be analysed. Each test costs about five pence.

NOTES.

The oil engine uses up between a half, and one tin of oil a day, when crushing and pumping.

The oil engine water tank must be kept full otherwise you get hot bearings. Oil wicks must be taken out as the engine is stopped to prevent waste of lubricating oil.

The 25 h.p. boiler requires three cords of wood and a little coal per day.

Cotton seed casks are used for shipping the concentrating juice, these are thoroughly cleaned out by the use of Lewis Dye Sifting top soap, one tin to eight gallons of water cleans thoroughly from four to five casks.

NURSERY WORK.

At the Reunion Experimental Station, the lime seedlings are raised in beds in a dry situation, the seeds are thickly sown and when up about three to four inches high, are transferred to beds 100 feet long by 5 feet wide, the seedlings are planted out at eight inches apart, thus each bed holds 1,000 plants, when the plants are from 12 to 18 inches high they are sold; as each order comes in the required number of plants are removed, from the beds, roots trimmed, tops of the plants removed, and tied in bundles of fifty plants, their roots are well soaked in or puddled in mud, the bundles are tied up in dried plantain leaves, watered and forwarded, in this way there is a great saving in transport charges, and very little loss occurs, plants sent out in this manner have been planted out a fortnight after arrival at their destination without any loss.

At Reunion the lime beds are so arranged, that the intervening space (path and drain) between each bed is planted with the Sword or Horse Bean *Canavalia ensiformis*. When the limes are removed the beds become the paths, and so on, in this way the land holds out for a longer period before new soil is required.

PLANTING DISTANCE.

The question, at what distance to plant lime trees in starting new cultivation is a difficult one and can only be decided on location, type of soil and rainfall, in any case most of the cultivations I saw, the trees were too closely planted and most of the young cultivations are now being planted at from twenty to thirty feet apart.

Trees planted too closely had their branches intermingled, were straggling for the light, with an unthrifty appearance, and the lines were difficult to collect from under the trees. Those planted well apart had a healthy appearance, were domed shaped, and the crop was easily gathered.

TOBAGO CONDITIONS.

The people have not given as readily as one had hoped information of the number of lime trees, and whether their fruit would be available for the factory. I think a circular similar to the one issued by the St. Lucia Government (already given in detail in this report) would be a means of stimulating interest in the lime industry. I am convinced that as soon as the people get to know that they can get ready money for their fruit, at least 1,000 barrels of limes will be forthcoming, as

there are numbers of lime trees in the districts of Moriah. Mason Hall, Les Coteaux, Adelphi, Morne Quiton. Mt. St. George, Sandy Point, and in and around Scarborough.

Some of the larger estates have gone in for lime cultivation on a small scale, none of them with a large enough acreage to justify the erection of a factory of their own for some time to come, I have no doubt, that the planters will also find the factory very useful to them for the first few years, or until they find it worth their while to work their own factory. The question of transport is a serious one in Tobago, but can be got over even in the most remote districts by the people erecting their own small crusher, squeezing the juice from the fruits, and sending to the factory in casks, by coastal boat, carts or motor-lorry.

The Cotton Ginnery building in Scarborough, on the wharf, is a suitable building, and is on a suitable site for the factory.

Mr. de Verteuil, the District Officer, Tobago, and myself, have gone over the St Lucia plans and compared the two buildings and find that with but slight alteration and addition the necessary plant can be installed in the existing building.

The water supply appears ample.

The site on which the building stands is suitable in every way, for buying locally, receiving from around the coast, and the North coast of Trinidad and shipping the finished product.

There is at present a 25 H.P. Locomotive Boiler and some steam pipes, which I understand the Ice Factory Company wish to sell. If this boiler is sound and of good quality, it might be to Government advantage to purchase it, this boiler is already fixed up, in a suitable place ready for immediate work.

I attach two photographs, one of the St. Lucia Factory, and the other showing the method adopted in raising lime plants for distribution.

December 29, 1917.

(Sgd.) HENRY MEADEN,
Manager, Govt. Farm, etc., Tobago.

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BLACK EYE PEAS.

THE BLACK-EYE PEA WEEVIL.

By F. W. URICH,
Entomologist Board of Agriculture.

Figs. 1-6.

THE whole question of the preservation of black-eye peas rests more on the control of this weevil than on anything else. Moisture may also occasion some damage but as a rule weevil infestation is the chief cause of the deterioration of black-eye peas when kept for any length of time in storage.

The weevil is well known to the country people and they are so accustomed to attacks of weevils that most of them say that it is impossible to keep weevils away from black-eye peas as they are generated by the peas. In consequence no effort is made to keep weevils away from peas and as soon as the crop is reaped the prevalent idea seems to be to sell and resell as soon as possible as black-eye peas will not keep longer than three months.

DISTRIBUTION.

The Black-eye pea weevil or *Pachymerus quadrimaculatus*, Fabr. is of tropical origin but is now cosmopolitan. According to Chittenden the original description was drawn up from specimens from Santa Cruz, West Indies. The weevil is found in most countries where cow peas are grown and is said by Chittenden to be acclimated as far north as Iowa.

FOOD.

The Black-eye pea weevil lives in stored products and in Trinidad is generally found infesting black-eye peas and imported cow peas originating from the United States and Venezuela. Recently harvested peas appear to be more liable to attack.

NATURE OF DAMAGE.

The damage to the peas is done by the feeding of the larva of the weevil and continuous generation, which goes on until the peas become unfit for even the insect themselves to live on.

LIFE HISTORY.

The egg is laid by the female beetle on the outer skin of a pea when in storage, cases of infestation in the field have not been noted. Fig. 1 A represents an egg (magnified) as laid by the female. It looks like a small ivory coloured speck. The larva hatches within a week and eats

in the pea making a small chamber as figured in fig. 3. When full grown the larva turns into a pupa from which the perfect insect issues and leaves the pea through a small circular hole as shown in fig. 2. Pupal cells can always be located by a slight darkening of the skin of the pea as shown at B. fig. 1. The whole development from egg to perfect insect takes about 30 days and as soon as the female issues from the pupal cell she is ready to copulate and start a new brood. As a rule only one egg is laid on each pea, but in a heavy infestation several may occur.

DESCRIPTION OF THE WEEVIL.

The general aspect of the weevil is dark brown with black spots and markings. The wing cases are reddish brown, the two semicircular markings on the outer margins are black and stand out conspicuously from the reddish brown colour. There are also indistinct white and gray lines. The thorax is dark brown. Fig. 4 represents the weevil enlarged and natural size.

NATURAL CONTROL.

The larvæ are preyed upon by a small four winged fly of a black colour, a species of *Chalcid* which is always found associated with the weevil. The little chalcid is well known to the country people who call it the young stage of the weevil. The parasite controls the weevil to some extent. Like the weevil the parasite escapes from the pea through a small circular hole as shown at C fig. 1. It will be seen that the parasite's hole is smaller in comparison with that of the weevil.

ARTIFICIAL CONTROL.

Weevils in peas can be destroyed by fumigation with carbon bisulphide or ant poison and if the peas are stored in a dry bin, tank, silo or any receptacle into which weevils cannot enter they will not be reinfected. As soon as possible after reaping peas should be dried and then stored in weevil proof places. Before the peas are put into storage they should be examined for any weevil eggs and if any are found they should be fumigated.

FUMIGATION.

The most important thing to remember in connection with practical fumigation is to understand that the more air tight the fumigator the better the fumigation will be. Any box, barrel, tank or silo can be used provided it can be made air tight. Ordinary boxes or barrels can be rendered gas tight by lining them with paper. An open top barrel or box can be covered with a tarpaulin or wet bags.

USE OF CARBON BISULPHIDE.

Carbon bisulphide should be used in the proportion of 5 lbs. to every 1000 cubic feet. One pound of carbon bisulphide is equivalent to about 20 fluid ounces. A rough and ready way of calculating the quantity of carbon bisulphide to use is to allow one fluid ounce or 8 teaspoonfuls for every bag of peas to be fumigated. The bisulphide should always be

placed on the top of the mass of peas in a shallow tin and the fumigator kept closed for 24 hours. Peas should always be aired after fumigation.

STORAGE.

In connection with storage it is important that all receptacles or rooms used should be made as weevil proof as possible; doors, windows and covers should fit tightly and all ventilating openings should be covered with fine wire gauze. Cleanliness is very important and no remnants of peas are to be left over from one season to another and so carry over infection.

In places where much peas are handled it is recommended to have a special fumigating chamber capable of holding about 25 bags of peas and isolated from the store.

Figs. 5 and 6 represent earthen bins as used in India taken from the *Agricultural Journal*, Department of Agriculture, Bihar and Orissa, October 1915. They can be made of tapia and of any size according to needs. It is important that the bins should rest on small pillars about a foot above the ground so that air can circulate at the bottom of the bin. The cover is made of tapia also and should be hermetically sealed down.

STORAGE OF PEAS FOR SEED PURPOSES.

Peas intended for planting should be specially treated and when fumigation is necessary they should not be exposed to the gas of bisulphide for more than 12 hours. After fumigation they should invariably be properly aired. A good plan is to carefully select weevil-free peas and keep them in a demijohn or iron drum well sealed down.

FUTILE PRACTICES.

Sprinkling peas with kerosene oil and rubbing it in is supposed to prevent weevil infection. Peas treated in this manner at Débé were examined in January this year and found to be infested. The salting of peas is also of little use against weevil attack.

CAUTION.

In connection with all fumigation operations and handling of carbon bisulphide it must be carefully noted that this chemical is highly inflammable; when fumigation is going on no lights, pipes or cigarettes are to be brought near the fumigator.

STORAGE OF BLACK EYE PEAS.

Regulations.

The Department of Agriculture will have storage capacity at the St. Augustine Estate, St. Joseph, for about 650,000 lb. of Black eye peas, *i.e.* about 8,000 bags of 220 lb.

Peas will be kiln dried and stored at a charge of 10 cents per bag per month; minimum charge per bag 20 cents. A reduction of ten per cent. of the weight of peas will be made to cover loss in drying.

Peas sent for storage must be shelled, sun dry, clean, and sound. The Department reserves the right to reject or to accept only under special terms any peas not up to the above standard.

Peas should be consigned to the Manager, St. Augustine Estate at St. Joseph Station. A charge of one cent per bag will be made for cartage to or from the station. Bags, &c., can be returned or stored if desired.

Peas can be withdrawn from storage in quantities of not less than one bag at any time provided all charges due have been paid.

June 7, 1918.

W. G. FREEMAN,
Acting Director of Agriculture.

EXPLANATION.

FIGURE 1.—Black eye pea, showing (A) Egg of weevil; (B) Pupal cell, (C) Exit hole of parasite.

FIGURE 2.—Black eye pea showing exit hole of weevil.

FIGURE 3.—Black eye pea split to show damage caused by feeding of larva.

Figures 1-3 magnified.

FIGURE 4.—Black eye pea weevil, magnified and natural size.

FIGURES 5 & 6.—Bins. as used in India, for storing peas, made of grass and mud, commonly called "tapia" in Trinidad.

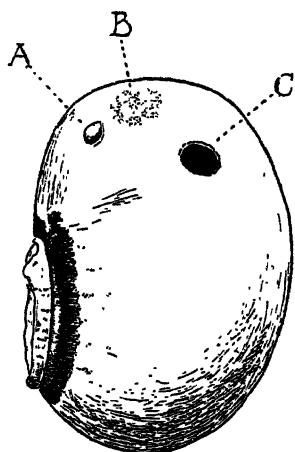


Fig. 1.

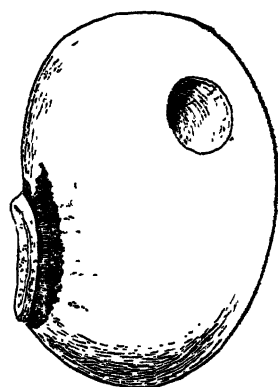


Fig. 2.

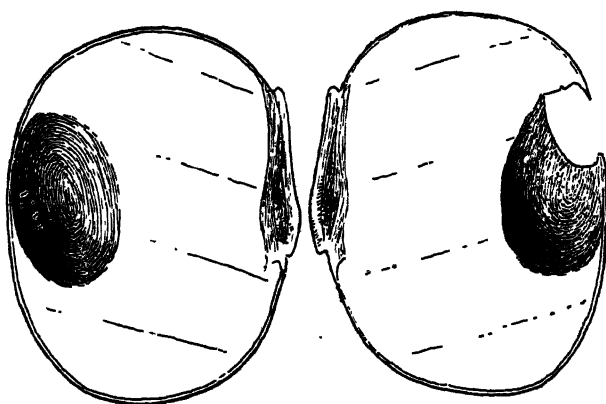


Fig. 3.

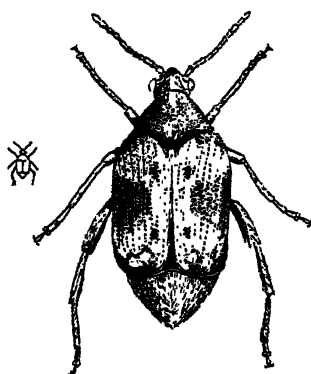


Fig. 4.

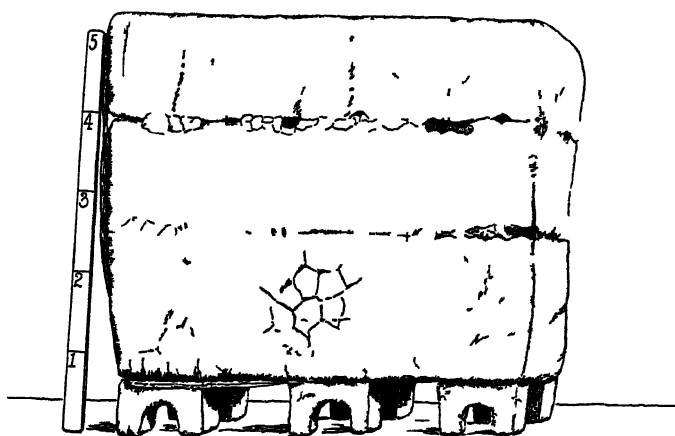


Fig 5

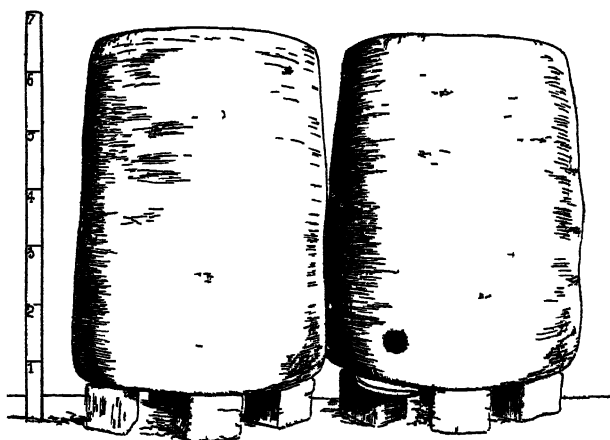


Fig 6

Earthen or 'tapia' bins for storing peas

FRUIT.

THE CULTIVATED FRUITS, AND NUTS, OF
TRINIDAD AND TOBAGO.

By W. E. BROADWAY.
Horticulturist and Assistant Botanist.

UPON several occasions attempts have been made to establish a permanent fruit business, but without satisfactory results, if the colony is referred to as a whole. Circulars, pamphlets and bulletin articles were written and, in this respect, it had the powerful support of His Excellency, Sir William Robinson, K.C.M.G., whilst Governor, 1885 to 1891. Under his direction Mr. J. H. Hart, F.L.S., then Superintendent of the Botanical Department was particularly engaged in furthering of these efforts. Everything practically was done, officially, to materialize the wish and the aim of Sir William, but the colony's fruit trade up to the moment of writing is yet in its infancy.

These facts are merely mentioned to shew the activity displayed concerning a fruit trade at that period.

In 1908 Mr. W. Symington arrived from England to handle the matter. He travelled through several of the West Indian Islands to get in touch with the planters and attended meetings of Agricultural Societies. When matters seemed to be shaping on satisfactory lines Mr. Symington was killed on the railway line, at Port-of-Spain, by a moving train whilst in conversation with another gentleman (Dr. Murray) who also met his death at the same time and under similar regrettable circumstances. This sad incident closed further enterprise for the time being. Since then others have made various efforts, but to the present day, Trinidad is without any considerable export trade in fruit. Recently, however, the Agricultural Society has considered the matter and as the outcome of its deliberations it has appointed a Fruit Committee with Mr. W. G. Freeman (Acting Director of Agriculture), Chairman. The report of the Committee will, it is hoped, be the means of establishing at least business activities and at the same time of standardizing the quality of the local supply.

True, Trinidad and Tobago produce excellent mangoes, oranges, grape fruit and avocado pears, shewing that soil, climate and other conditions are suited to fruit culture. In Tobago, in particular a considerable industry might be worked up, and if proof were wanting one could point to luscious mangoes which come across to Port-of-Spain in their season as well as its grape fruit, Lybuan pomelo (Macgillivray pomelo), sapodillas, sugar apples, avocados and oranges. In that island-ward Mr. R. Bruce Archibald (Roxburgh), Mr. D. Macgillivray (Franklyns near Plymouth), Mr. G. David Hatt (Cinnamon Hill near Government House), and Mr. Honeychurch Thomas (Scarborough) give special prominence to the cultivation of fruit, whilst the Botanic Station, at Scarborough, has a representative series of mangoes, oranges, grape fruit, &c. Within recent years the Department of Agriculture and

private persons have been introducing into the colony the best of oranges, grape fruit and mangos and avocados so that material for propagating purposes is available to push ahead immediately. In connection with the rearing of citrus fruits for distribution it might be mentioned that no longer than a quarter of a century ago the custom was to raise everything from seed. Now no progressive fruit-grower thinks of putting down an orchard of citrus trees (except limes) which has not been budded, seed rearing being practised only to obtain seedlings of the sour orange, and rough lemon for stocks. Orange buds will travel safely, for days at a time through the post, if packed in damp moss and secured within a wooden or metal box. An instance may be cited. Some years ago there was sent from Dominica (B.W.I.) to Grenada a package so prepared and upon receipt the eye or bud parts, had calloused over revealing a clean, healthy appearance and illustrating how easily it is to transmit citrus buds from one part of the West Indies to the other. This is an important point to note for it removes any obstacle in adding varieties we may not have in our collections but which are grown, and cultivated, in other places.

For export purposes, the Fruit Committee of the Agricultural Society has recommended that, at the beginning, attention should be directed to mangoes, oranges, grape fruit and avocado pears, and to commence as early as possible in the preparation of standard varieties for distribution and for orchard cultivation. At the St. Clair Experiment Station one thousand sour orange stocks are ready to be budded at the time of writing.

AKEE (*Blighia sapida*)—This is not in the true sense a dessert, or table fruit. The portion eaten is that part (arillus) into which is fixed the black shining seed and it is only eaten when cooked. The Akee is little known in these southern West Indian Islands but no orchard should be considered complete without it. The tree bears heavily and when the fruits ripen they turn red and are unusually effective as they hang from the branches. It is largely used in Jamaica.

AVOCADO (*Persea gratissima*).—Locally the avocado is often spoken of as pear, or zabricot, and is eagerly sought for and bought by the better classes. We are assured by Mr. Eugene André, a Trinidad gentleman connected prominently with the exportation and importation of plants, that nothing in the fruit line has more rosy prospects for Trinidad than avocados of class and quality. Budding was never adopted until within the last year or two. In by-gone days only seedlings were raised but now, as in the case of oranges, no one should think of using any other but budded material. At the St. Clair Experiment Station seedlings are not issued, unless at special request. Respecting kinds available, occasionally first class ones are met in Trinidad and Tobago. Four may be considered worthy of notice in the collections at St. Clair; the imported "Trapp" which so far has not lived up to its American reputation, and three local varieties, the "St. Clair," the "River" and the "St. Ann's." The drawback in the getting of mature avocados to markets outside of the West Indies is the suddenness of their ripening after attaining to the pitch of what is known as "full." However, with cold storage it has frequently been proved, that avocados carry safely to New York or

to the United Kingdom. The avocado tree thrives in Port-of-Spain and its suburbs, yet in many other parts, where one would expect to see it prospering, it refuses to grow. At Sangre Grande, for instance, where cacao flourishes, the avocado apparently is not at home. It is a fickle subject, and it is difficult to understand why, in some places, it refuses to thrive. Splendid avocado fruit come to town from Diego Martin; and good ones also from Tobago.

CITRUS FRUITS.—Under this head fall citrons, grape fruit, lemons, limes, mandarins, shaddocks, sweet oranges and tangerines, &c., all of which grow well in the cooler and moister positions which lie in the open valleys, sheltered hill-sides and flat lands. Efficient drainage is absolutely necessary for their successful cultivation; on the other hand dry, wind swept localities are to be avoided. Remarkable results, however, are attained at Diego Martin, where Mr. E. M. Lazare has systematically laid down a citrus, and mango orchard at Lazdale. One would perhaps have doubted the possibility of growing oranges successfully in this comparatively dry and open position. The chief secret lies, as the proprietor informs us, in attention to two details; these being the regular mulches applied to the surface, and in the second place to a system of water pockets, enabling the capturing, and conserving, of the rain water in the land, down and through which it finds its way from the pockets; and the retention of moisture at the root by means of cut grass, &c., used for mulching purposes. Heavy yields of fruit are annually got from here.

CITRON (*Citrus medica*).—This, of course, is not a dessert fruit but it is valued economically on account of the rind which is made up into the popular candied peel of commerce. It thrives in both Trinidad and Tobago.

GRAPE FRUIT (*Citrus decumana* var.).—Aside from the lime there is no citrus fruit which promises better, or more profitable returns, than the best kinds of grape fruit (Forbidden Fruit) for local and foreign markets. Excellent "native" types already are established in Trinidad and Tobago. Through recent importations from Porto Rico, etc. by the Department of Agriculture, and private persons, we now have in the colony, Bowen's Late, Conner's Prolific, Duncan, Marsh's Seedless, Pernambuco, Walter's, Foster (pink flesh), and Williams. Most of these are at the St. Clair Experiment Station so that bud-wood is available for immediate use. There is an excellent strain also at the Botanic Station, Tobago.

LEMON (*Citrus medica* var. *limonum*).—The lemon is not cultivated for eating purposes but forms the basis in the preparation of "lemon squashes." Sliced pieces of the fruit are also used for flavouring cooked fish by squeezing out the raw juice upon it similarly as is done with limes. Seeds of the rough lemon are sown to raise stocks for budding sweet oranges, grape fruit, &c., upon. Lemons thrive and bear abundantly in the colony.

LIME (*Citrus medica* var. *acida*).—With limes a trade is being developed and to meet the demands of planters thousands of plants are prepared and distributed each year from St. Clair Experiment Station, and the Botanic Station, Tobago. From the nurseries of the St. Clair

Experiment Station during, 1917, 20,824 seedlings were issued. Limes are not used as dessert in the West Indies but to furnish lime juice citric acid, essential oils, &c. Of varieties there are the common or spiny one (possibly the best of all), the spineless and seedless forms.

THE GRENADINE ORANGE (*Citrus* sp.).—This bitter-sweet, juicy fruit originated on the neighbouring island of Grenada and possibly was the result of crossing, accidentally, the mandarin as one of the parents. Apparently it comes fairly true from seed, but the safer way, as with other citrus fruits, is to fall back upon the sure plan of budding. Tastes vary for we find some persons fond of it whilst others have contrary views. It is worth a place in the orchard.

MANDARIN (*Citrus nobilis*).—Good mandarins are cultivated in Trinidad equalling the best strains so highly regarded in Grenada, but the number of trees of this class is at present limited. The smaller fruited variety a prolific bearer is sometimes referred to locally as Nartjé, a South African name.

SWEET ORANGE (*Citrus Aurantium*).—So freely and readily do sweet oranges grow in these islands that there are to be found now numbers of half wild (cacao oranges) trees established throughout the colony and producing fruit by the thousand every year. These find immediate sale in the city and the suburbs. None of the trees originated as budded plants but have appeared usually as chance seedlings. Within recent years the marketable sorts of Florida, U.S.A. have been imported and planted out on private and public lands. Private persons especially interested this way are Mrs. Eliza Stollmeyer, Mr. A. V. Stollmeyer, Mr. E. M. Lazare, Dr. J. Senior, and Mr. A. B. Carr. Mr. J. B. L. Todd, although not an importer, has a choice lot of oranges, grape fruit, the Labuan pomelo (Macgillivray pomelo), mandarins and tangerines at Cascade, St. Ann's. His oranges comprise the Navel (the best of all commercial oranges and one consequently in greatest demand), Pine-apple, Ruby, Parson Brown, St. Michael's Blood, &c. The collections at the St. Clair Experiment Station include these with the addition of Homosassa, Jaffa, King, Los Iros (a fine variety from the Erin district), Majorca, Sandford's Mediterranean, Satsuma, St. Michael and Tardiff Hart's Late.

TANGERINE (*Citrus nobilis* var.).—Tangerines are popular fruits in Trinidad where they ripen with a clear, bright yellow colour. They grow freely from seed and therefore are scattered throughout the island being especially plentiful at Chatham and Irois. An imported variety, the Dancy Tangerine, bears regularly with Mr. Todd at St. Ann's. Another smaller fruited example un-named is growing in the orange avenue of the principal entrance to the St. Clair Experiment Station but only represented by a solitary tree. Each of these tangerines deserves to be propagated and distributed into all orchard collections of Trinidad and Tobago.

PORTUGAL CRANGE (*Citrus* sp.).—Far too seldom is this delicious little orange met, for outside of those grown by Mr. E. M. Lazare at Diego Martin, and Mr. A. B. Carr at Caparo, there does not appear to be any.

BERGAMOT ORANGE (*Citrus Bergamia*).—The Bergamot grows and does fairly well with us; and in other places it is cultivated for the essential oils obtained from the rind of the fruit. It is suggested that its merits are worth looking into as to whether, or not, it would be advisable to plant it up in the colony as a commercial asset. There is a small plantation of it near Carenage.

THE SEVILLE OR BITTER SWEET ORANGE (*Citrus vulgaris*).—The principal use of this fruit-tree is to supply seed for the rearing of seedling plants to act, as stocks, in budding commercial citrus fruits upon; and for the cleansing of floors to dwellings with its juice, and further, it is an important object in orchard work because of the hardy, gum-disease resisting character of the stocks got from sour orange seed.

MANGO (*Mangifera indica*).—At present certain varieties of the mango hold premier position among the fruits of the colony. They have many advantages as the trees are hardy, do best in the lower levels and flourish when the air is influenced by the sea as well as in places further inland. Trees are prepared by the method known as inarching (grafting by approach), seedlings of the common forms such as mango verte being used as stocks. Some of the finest mangoes come from the Botanic Station, Scarborough, Tobago, which is situated near the sea. Periodical spraying with bordeaux mixture has been found of advantage in the St. Clair Experiment Station to keep off attacks of certain specific diseases. The Julie, Peters, Ceylon No. 1, Minnie, Gordon, Martin, Pere Louis, and Zabricot are varieties that are regarded as being in the first rank for quality, although the Julie enjoys the distinction of being preferred for market purposes. An orchard of Julie mangoes is a little fortune in itself, the fruit of which sell from four to eight cents (2d. to 4d.) each. This kind has been found to be a good shipper so there need be no hesitation in urging its extended cultivation.

The Department of Agriculture has about forty varieties under cultivation.

There are several fair private collections of mangoes in the colony but for range of variety, and quality that of Mrs. Patterson's, St. Ann's, is perhaps the best. At Diego Martin, Mr. E. M. Lazare has a young orchard of Julies coming on, and in the Santa Cruz Valley Mr. A. V. Stollmeyer has numbers of the same kind.

CUSTARD APPLE (*Anona reticulata*).—This particular custard apple is not thought much of as a dessert fruit so that it is merely listed because it seems to be grown and appreciated by persons here and there.

THE PAPAW (*Carica Papaya*).—Papaw fruits are too delicate to keep after they start ripening but in the green or unripened condition they are made use of as a vegetable in a similar way to pumpkins, and squashes. When mature, and once the taste for them has been acquired, they are regarded among the best of fruits. Recently, from the village of St. James, came a large, long shaped example which contained not a single seed and of good quality. The smaller, and round shaped fruits, more frequently met are sweet, and nice eating,

and by some persons are preferred to the bigger ones. The life of the papaw is a short one and as a fruit yielder it is worth but little after the second year of its existence. Vegetable pepsin forms from incised skin wounds made in the surfaces of the immature fruits whilst still attached to the parent plant. Collecting papaw pepsin receives no attention locally but it may be worth while enquiring into with a view of finding out if it would pay, or not, the grower. Both in Trinidad and Tobago the papaw plant is occasionally subjected to disease which kills off the upper parts, and so far as known, at present, there appears no way of preventing it, nor has the cause yet been determined.

SAPODILLA (*Achras sapota*).—This is the naseberry of other places. The varieties of the sapodilla are fairly numerous and they vary in size and quality some being large whilst others are small, and they differ widely in flavour, as well as to a lesser extent, in colour of flesh, which is either dark-brown, or nearly white. The Tobago sapodillas are free from "worm" (grubs) and are among the very finest in quality. Those produced in Trinidad invariably are attacked by these objectionable creatures which makes the eating of a Trinidad sapodilla anything but pleasant at times. Sapodillas are luscious, juicy, sweet fruit and might with advantage to the island be largely planted in Tobago with a view of helping to supply the wants of Trinidad, Barbados, etc. The plants are reared from seed as budding so far appears to be impracticable.

Like the avocado, sapodillas ripen so rapidly once they get to the state of being "full" that, for export purposes, these too would require special facilities on board steamers to carry them safely to the American and Canadian markets.

Old trees as known in these islands and from which come the fruit used as dessert, oftentimes grow into quite large sizes. Fairly dry conditions at root suit this fruit-tree.

The famous chicle gum comes from wild sapodilla trees.

SOUR SOP (*Anona muricata*).—The fruits of this small tree are large and greenish coloured externally when ripe. They are much liked in the flavouring of ice creams. Some varieties are better than others but it is doubtful if they would ever find a place in the export list.

Leaves of the sour sop are made into a kind of tea-beverage, and they are also used for a "bush bath" during fever attacks.

STAR APPLE (*Chrysophyllum Cainito*).—The star apple (caimite) fruit is one over which perhaps there is considerable difference of opinion as to its merits. The colour of the mature fruit is either a dark purple, or pale green. Down at the Irois Forest post office, there is growing a medium size tree which yields enormous fruits, being by far the largest seen in any place and which, when ripe, are of the pale greenish-white colour externally. In quality they are of the best. Seed of this particular tree should be acquired and plants raised from them for distribution into other parts of the colony. Here and there is to be met a small plum size star apple and although palatable is scarcely worthy of notice for orchard purposes. Star apples are only raised from seed at the present time.

SUGAR APPLE (*Anona squamosa*).—Sugar apples are much liked, especially by the masses, who appreciate the excessive sweetness characteristic of them. The tree, itself, is of small size and grows in sandy, dry lands near the sea, and along seashores, where they bear freely and heavily. The fruit ripens quickly and so is unsuited for long journeys. There is a beautiful purple coloured form which is rare and seldom met. Sugar apples do very well in the Leeward district of Tobago, at Chacachacare, etc.

THE LITCHEE (*Nephelium litchi*).—The litchee is all but unknown in the colony as a cultivated tree. There are one or two old specimens in the Royal Botanic Gardens and two smaller plants in the St. Clair Experiment Station the latter from seed received from Mr. H. Hancock from China. The litchee is a Chinese fruit and is delicious and pleasant eating so that there is apparently no reason why we should not pay attention to it and plant it up in orchard collections. The present Governor His Excellency Sir John Chancellor, R.E., D.S.O., K.C.M.G. recommended at a recent meeting of the Agricultural Society that both this and the Mangosteen should be extensively planted in these islands. The past experience with the older trees has been that they fruit but seldom.

MANGOSTEEN (*Garcinia mangostana*).—For many years this eastern fruit has been represented by two specimens in the Royal Botanic Gardens, St. Ann's. At the present moment the older is still alive, although, not as vigorous as formerly due more to the injury done sometime back by an overhanging bough of another tree which fell upon it and partly smashed many of its branches, than to old age. At the St. Clair Experiment Station there are healthy young trees which bore a large crop last year (1917); and on more than one estate in the colony mangosteens are reported as fruiting satisfactorily.

This fruit tree deserves to be planted wherever it will thrive. When it is remembered that the soil, at St. Clair, is not of the best it will be seen that the mangosteen is not partial to rich lands and that there should be no difficulty in getting it established. Raised from seed although very difficult to rear successfully out of the seedling stage.

Seedlings are stocked for sale in the St. Clair Experiment Station nurseries.

GOLDEN APPLE OR POMME CYTHERE (*Spondias dulcis*).—There is a pleasant, acid flavour connected to a good pomme cythere fruit. Trees of it are scattered throughout the colony but in no sense can it be said to come within the limits of a trade-fruit as at present grown. No orchard on the other hand can be considered complete without one or two trees of it. The fruit makes excellent jam.

JAVA PLUM (*Eugenia Jambolana*).—In the Botanic Gardens there still stands an aged specimen of the Java plum or as it was better known twenty to thirty years ago among the boys of that time who regularly found their way to the front part of the Gardens. It can hardly be considered as a dessert fruit.

POMME-MALAC OR MALACCA APPLE (*Eugenia malaccensis*).—During the time this tree is blossoming the ground underneath becomes clothed in a coloured carpet on account of the quantities of fallen flowers. The pomme-malac, when of the best, is a nice fruit although it in no way ranks with a good pine apple, or mango. It is cultivated generally in country districts and liked by the peasantry: stewed it resembles pears in flavour.

GUAVA (*Psidium Guajava*).—Two varieties of Guava are usually met in the colony. The common form which grows spontaneously in open pasture lands, where it drives nearly everything off the ground with its thick growth. The other is recognized as the Spice guava, for example the well known local variety, the McLean guava. These develop generally into fair size trees, so also does the ordinary, or common kind, if left unmolested for a number of years.

The jellies, and stews, made from the fruit are esteemed to a high degree in the West Indies, as well as the more solid substance, guava cheese. Lately attention has been drawn to a tiny fruited small tree in the grounds of Mr. J. Adhemar Perez, Belmont, which originally is said to have come from Venezuela. The fruits are whitish, when ripe, suggesting in shape and form white currants (*Ribes*) of temperate countries; and in taste are pleasant and nice eating. In the Botanic Station, Tobago, there is yet another guava, bigger berried than Mr. Perez's which, also, is a nice little fruit. The last two kinds are worth planting and deserve a place in the garden, or orchard. The guaras, as a whole, require looking into and brought more to the general notice of the public. Like sapodillas Trinidad guavas are very subject to insect attacks from which the Tobago fruits are practically free.

GOVERNOR PLUM (*Flacourtia Ramontohii*).—Besides being useful for fruit-producing, Governor plum plants, closely planted, form impenetrable hedges as they throw from the main stem and branch parts strong compound spines. At least two forms of this fruit are known, one larger in size than the other but so far as quality goes there is apparently little to choose between them. Full grown a governor plum tree is only of medium size, thick set, and when in foliage glistens with the number of small shiny leaves. The fruits constitute very fair dessert, and also make excellent jelly.

BANANA OR FIG (*Musa sapientum*).—The banana is universally cultivated throughout Trinidad and Tobago in one form or the other especially where young cacao cultivations are being established as it is the most useful of all plants in furnishing the necessary early shade. The best of the bananas, as dessert fruit, are the Gros Michel (from Jamaica), the Governor fig, (Canary banana), the Sucrier fig (lady's finger) Silk fig, and the apple-banana (from Demerara). Recently banana meal has come into requisition for flour and bread-making. The Moko fruits when ripe, sliced and fried are appreciated. Plantains (a variety of *M. Sapientum*) come under the head of vegetable products although their fruits, when ripe, are used in a similar way to those of the Moko. To the true born West Indian there is no fruit which equals in his estimation that of the plantains no matter in what way they are served to table.

MISCELLANEOUS FRUITS.—Other fruits made use of as dessert, or for preserve, or jam making, are:—Barbados cherry (*Malpighia glabra*); Mammy apple (*Mammea americana*); Genip (*Melicocca bijuga*); Balata (*Mimusops globosa*); the Dell apple or pomme d'liane; and the Granadilla or Babadine. (two passion flowers, vines, and of the genus *Passiflora*), Tamarind (*Tamarindus indica*) used in syrups: Tamarind des Indes (*Tangueria edulis*), Water melons (*Citrullus*); Pine-apples (*Ananas*); Grapes (*Vitis*) Jamaica plum (red). Chili plum, (yellow), each belonging to *Spondias*; Gooseberry (of the West Indies), (*Cicca disticha*); coolie tamarind and condicion (*Averrhoa*). Occasionally one comes across a fruit known as Kashima which is relished and liked by many persons. It is one of the wild *Anonas* and might be looked into to ascertain its status among the dessert fruits of the colony.

NUTS.

Under this section there are but few nut-producing plants to consider. They are the Brazil nut, the Butter nut, the Sapucaya nut, the Cashew, the Pistache or ground nut, and the Queensland nut.

BRAZIL NUT (*Bertholletia excelsa*).—The oldest specimen in this island (Trinidad) is in the Royal Botanic Gardens, where it yields, each year, it's returns of hard, round box-like cases which hold the seed. At the Government Farm, St. Joseph, there are also bearing trees but outside of these two places it is seldom seen in the colony. Brazil nuts deserve to be planted systematically. They develop into very large trees and apparently take about ten years or so before they fruit.

BUTTER NUT (*Caryocar nuciferum*).—This is the souari timber tree of the British Guiana forests. For a number of years one or two trees in the Botanic Gardens have been producing these delicious nuts which suggests that, in better and more favoured positions, it would yield heavily; for soil, and conditions, are anything but good in these gardens, Butter-nuts are exceptionally nice eating and find ready sale in home, and foreign, markets. The edible portion is enclosed within a hard shell which can be cracked open without much difficulty but which when planted often lie dormant for months with no sign of life. Unlike the Brazil nut the seeds are few in number to each ball shaped fruit and embedded in dryish pulp material. The Butter-nut might be profitable were it cultivated on a large scale in Trinidad and Tobago.

THE SAPUCAYA NUT (*Lecythis Zabucajo*).—Sapucaya nuts of the Amazon region are spoken of highly as being first rate eating and nutritious. No fruiting trees are known in the colony. A short time ago seed was obtained, and plants of it raised in the St. Clair nurseries, for distribution. Some of these have made good growth in wet districts. At Port-of-Spain they failed. Mr. Eugene André has promising young trees coming on in his Dabadie nursery near Arima. It appears worthy of cultivation in suitable localities.

CASHEW NUT (*Anacardium occidentale*).—Everyone is familiar with the cashew nut (technically a fruit) which has to be first roasted before being eaten. Locally, cashews are consumed in fairly large quantities; and latterly attention has been directed to them with the result that

areas are being planted on the drier and exposed parts of certain localities, where cacao will not grow, but which suit the cashew. The highly coloured fruit-like portion is very juicy, and edible, raw or cooked. Some fruits are rather astringent; and from a medical view point the bark and roots are valued.

THE PISTACHE OR GROUND NUT (*Arachis hypogæa*).—In Trinidad they are little grown so that supplies come to us from Barbados, &c. It seems a pity that local notice is not taken of the ground nut for the demand, by the public, is constant, and considerable, if one is to be guided by the rapidity with which in the roasted state they are sold by the hucksters of town and suburb. Rather sandy lands are the best for this annual crop.

QUEENSLAND NUT (*Macadamia ternifolia*).—Only one fruiting specimen of this is known to the writer and that is in the Botanic Gardens when it every year bears its small, hard shelled nuts. Squirrels are very partial to them so that it is difficult to collect sound seed even for purposes of propagation. Seedlings can sometimes be had from the St. Clair Experiment Station. Attention has been directed to the Queensland nut recently in the United States and elsewhere for dessert purposes.

THE DASHEEN; ITS USES AND CULTURE. (1)

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INTRODUCTION.

ANYONE who has travelled much in the Tropics or the Orient. and especially one who has visited the Hawaiian Islands, can hardly have failed to make the acquaintance of the taro. Even those who have become well acquainted with it and learned really to like it, however, probably have not thought of the possibility of its successful introduction as a food crop into the United States. But such a thing has already come to pass, and a variety of the taro known as the Trinidad dasheen, from the Island of Trinidad, West Indies, is now becoming established as a factor in the agriculture of the South.

There has been a growing need in the Southern States for more crops similar in character to the potato, to supplement the supply of that great staple food plant. The dasheen seems largely to meet this need. The comparative difficulty of growing more than one good crop of potatoes a year, the further difficulty of successful storage by small growers or dealers, and the fact that northern markets consume a large portion of the crop at good prices make the price of potatoes always high except in cities that are reached by water from the North when the supply is abundant there.

Dasheens for home use can be grown at small expense by most farmers in the South, and by many can be grown for local markets at prices no higher than for potatoes. Since the Trinidad dasheen contains about 50 per cent. more protein and 50 per cent. more starch and sugars than the potato, dasheens at equal prices would really be a cheaper food. This crop is adapted for cultivation in rich, moist, well-drained soils and matures in October and November. It requires at least seven months to reach full maturity.

Although the dasheen was introduced into the United States from the West Indies, it is believed to have come originally from China. This belief obtains partly because the name dasheen appears to be a corruption of the French phrase "de la Chine," meaning "from China," and partly because other varieties, very closely allied to it, have been found in southern China.

DESCRIPTION OF THE DASHEEN.

The Trinidad dasheen (2) is an especially fine variety of a particular type of the taro. As will be seen from the leaves, it bears strong resemblance to the ordinary elephant-ear plant [*i.e.* *caladium*]. The

(1) Reproduced from the *Year book of the United States Department of Agriculture* 1916, by permission of the United States Department of Agriculture which has kindly supplied the plates.—(Ed.)

(2.) Certain varieties of taros resemble the Trinidad dasheen, especially in the character of the tuberous part of the plant. These varieties constitute a distinct type of taro and are referred to here as dasheens. Where the dasheen is mentioned in this article the Trinidad variety is always to be understood. [*Author's note.*]

two are closely related, though the elephant-ear "tuber" makes very poor eating in comparison with the dasheen.

Each hill of dasheens usually contains one or two large, central corms, besides a considerable number of lateral cormels, commonly called tubers. (Fig. 1, 3 and 4). In rare cases there may be as many as three to five of the large corms in one hill. (Fig. 4). The corms of the Trinidad variety when grown in the right kind of soil are of at least as good quality as the tubers, and sometimes better. In texture and flavor the dasheen may be described as being between the chesnut and the potato.

ECONOMIC IMPORTANCE OF THE DASHEEN AND OTHER TAROS.

The taro, including the type recognized here as the dasheen, is one of the important food plants in most of the warm regions of the world. The culture of the crop is probably developed to a higher degree in the Hawaiian Islands than elsewhere. It is grown as an upland crop in certain parts of the islands, but much more extensively under irrigation. As an irrigated crop it is usually grown in patches from one-eighth to one-fourth acre in size, each plat being inclosed with dikes and being at a different level, so that the water runs from one to the other. The movement of the water is slow but continuous. The plants do not grow so tall as when grown in rich soil that is only moist. The season required for maturing a crop varies from 8 to 15 months, depending on the variety.

The taro is eaten in Hawaii boiled or baked, like potatoes, or in the form of poi. It is as poi that it is eaten most largely. In making poi the taro is thoroughly cooked, by steaming or boiling, and peeled. With the addition of a little water it is then reduced, either by pounding with a stone pestle or pounder, the old method, or by grinding with a modern mill, to a sticky mass. The pounding process includes the wetting of the empty hand in a vessel of water, kept at the side, at each fall of the pounder and moistening the lower surface of the pestle as it is lifted for the next stroke. When the paste, or poi, has become perfectly smooth from the pounding, it is usually put into a covered receptacle for a day or so, in order to ferment. Poi made by the modern process is fermented in the same manner. The old method is still in use to a limited extent.

The taro is credited, wherever grown, with being more easily digested than most other starch foods, and poi is held to be the most easily digested form in which it can be prepared. Poi, however, is a dish that does not appeal strongly to most persons unaccustomed to it, and its use has not spread among other peoples. The expected increase in the use of the dasheen, and perhaps other taros, will be as a vegetable, or in the form of flour for use in combination with wheat or other flours in baking.

In many countries where the taro is cultivated, because of the inferiority of the varieties grown and the poor methods of cooking it, the vegetable is esteemed but little by Europeans and Americans. In parts of China, according to Mr. Frank N. Meyer, Agricultural Explorer for the Department of Agriculture, the taro is in the class of luxuries, and the very poor can rarely afford to eat it. In Japan, where it is

classed among the so-called imos, it is said to be used by all classes of people, often being cooked with fish.

The taros and the yautias (another group of edible "aroids," as the plants of the arum family are called) are grown widely in tropical America and constitute a rather important part of the food supply of the native peoples. Dasheens, under the name "malanga," are brought from Cuba to Tampa, Fla., for the Latin-American people of that city.

For two centuries at least, from time to time, individuals have brought into the Carolinas and grown there on a small scale inferior varieties of the taro. Even now occasional patches of a rather strong flavoured taro, known as the tanier, or tanya, are met with in the South Atlantic States.

A very inferior kind of taro, somewhat similar to the tanier just mentioned, is grown in the eastern Mediterranean region, especially in Egypt, where it is called "golqas." It appears to be eaten only by the labouring classes. It has been imported into the United States, apparently for consumption by the oriental population in some of our eastern cities, but this market is now supplied by dasheens from the Southern States. Taros are also shipped to America from China and are sold in Chinese shops as "China potatoes."

INTRODUCTION OF THE DASHEEN.

Until the investigation of the aroid root crops was begun by the Department of Agriculture a few years ago, it does not appear that any serious attempts were ever made to grow them outside of tropical or subtropical regions except in Japan and China. As a preliminary part of this investigational work, there was assembled, first by Mr. O. W. Barrett, at the Porto Rico Agricultural Experiment Station, and later at Washington, D. C., the largest collection of varieties of these plants ever brought together. They were collected from every quarter of the globe where grown. From field tests made of these varieties in South Carolina and Florida it was found that the Trinidad dasheen, taking into account its adaptability to the climate and its food qualities, was especially well suited for culture and use in this country.

The propagation and testing work with the dasheen since 1911 has been carried on by the department principally at its Plant Introduction Field Station at Brooksville, Fla. (Fig. 2). A large number of people in the South, especially in the South-east, are now growing the dasheen for home use, stock feed, and market.

USES OF THE DASHEEN.

It is not intended that the dasheen shall displace either the potato or the sweet potato in any market. A greater variety of starchy vegetables is needed, however, and the dasheen has been welcomed by many as an addition to the small list of those foods now in use in the United States. But for the present at least, outside of the regions where grown it is not to be looked upon as a cheap food; the shipments are not yet large enough to bring the prices to the level which they may reach later. In the South, however, where the dasheen is grown it is expected that it will eventually come to be used extensively, partly as a

matter of economy, and especially during the long season when potatoes have to be shipped from the North.

Most persons when eating the dasheen naturally think of comparing it with the potato. Many say they like it better; others equally well; and some not so well. However individual opinions may differ as to the relative merits of the two vegetables, a sufficiently large number of persons who have tried the dasheen have been so favourably impressed that there seems to be no question of its ultimate popularity as a table vegetable.

Dasheens, as well as other taros, are reputed to be more easily digested than many other starch foods. This ease of digestion has not been scientifically demonstrated, so far as is known, but the belief is current and doubtless has some basis in fact. The extremely small size of the taro starch grain, one of the smallest known in food plants, may possibly have some connection with its digestibility.

PREPARATION FOR THE TABLE.

Dasheens are suitable for use in the same manner and in quite as many ways as potatoes, with slight modifications, which are necessary in some cases on account of the differences in the texture of the two vegetables. Some house-wives or cooks fail to get the best results, or fail completely, with dasheens at first, wholly from lack of care in following the directions for cooking and serving. It should be remembered that in order to give a new vegetable a fair trial every detail regarding its preparation for the table should be carefully followed. One common mistake is to bake or boil the dasheens too long; another is to cook them before the rest of the meal is prepared and so keep them standing for some time before they are served. Baked or boiled potatoes that are kept standing lose in palatability, and the dasheen loses quite as much if not served promptly. Dasheens do not require quite so long a time to cook as potatoes of the same size, and it is important to remember this, especially in boiling or baking them.

There is an almost endless variety of ways in which dasheens can be prepared for the table. A number of recipes have been worked out carefully and a few of these will be referred to here.

Baking is the most satisfactory method, in general, of cooking either large or small dasheens. Large ones (corms) are usually first parboiled for 10 to 20 minutes, in order to reduce the time necessary for baking and so avoid the possibility of charring the outside. A moderately hot oven is required. If the dasheens are well scrubbed, to remove the fibrous part of the skin, and the baking is properly done, a soft crust is formed, which is very delicious. Large dasheens may be served in the "half shell" if desired, the corms usually being cut in half before baking. They are made still more attractive by placing a lump of butter in a hole scooped out of the center of the cut surface. The halves of corms that are small enough can be served as individual portions and the larger ones used for several persons.

The interior of a well-grown dasheen is usually mealy when baked or boiled, though often more firm than a potato. It is sometimes of cream colour, but more often it is grayish white or tinged with violet. The same seasoning is used as for potatoes, but on account of the

comparative dryness of the dasheen more butter or gravy is generally needed. Too much importance can not be given to serving baked or boiled dasheens promptly after they are cooked.

Dasheens mashed like potatoes are likely to be too sticky to be attractive, but when put through a potato ricer after boiling or baking they make a most satisfactory dish. A ricer stronger than the ordinary ones on the market is desirable for the dasheen, because of its firm texture.

Scalloped dasheen made with either latticework or plain slices is a most satisfactory dish where a large company of persons is to be served and where the dish must of necessity stand for a time. The addition of a few slices of onion will bring out the dasheen flavour.

Stuffed dasheens, especially the large corms, are exceedingly attractive and when properly seasoned are as good as they look. The stuffed halves may be served one to a person or one for several persons, according to the size of the corms. (Fig. 7).

Dasheen crisps, made from raw dasheen with a fluted vegetable slicer and fried in deep fat, are declared by some epicures to be the most delicious of all dasheen dishes. (Fig. 6). The delicate nutty flavour of the dasheen is accentuated by this method of preparation. While these crisps are better when freshly made, they often keep their crispness for several days, depending on the amount of moisture in the air.

As a filling for fowl and other meats the dasheen can hardly be surpassed. Served *au gratin*, that is, cooked with grated cheese, it is equal to any similar dish. It makes a delicious salad and may be French fried or German fried, like potatoes. It can also be used boiled in making bread, as potatoes are used by many housewives, and with the same results. (Fig. 8).

DASHEEN FLOUR.

A very good flour has been made from dasheens. The corms and large tubers are pared and either sliced or shredded and then dried and ground in a flour mill. As the dasheen does not appear to contain gluten the flour can not be used alone in baking, but must be used in combination with wheat or rye flour. Excellent bread, muffins, biscuits, crullers, griddlecakes, soups, and various other products are made by using dasheen flour in part. A proportion of one-fourth or one-third of dasheen flour is generally used.

DASHEEN SHOOTS.

A secondary use of the dasheen is the forcing of the large corms for their shoots. These shoots are more tender than asparagus and have a delicious flavour not unlike that of mushrooms. (Fig. 9). They are forced in the dark in order to blanch them. The slight acidity which the blanched shoots contain is destroyed by the following methods of cooking:

(1.) Cut the blanched shoots into 2-inch lengths, pour on an abundance of boiling water, add salt, and boil for 12 minutes; drain,

pour on enough cold milk⁽¹⁾ so that the shoots will be completely covered when it boils, season with salt and boil for 5 minutes; drain, season with butter, and serve on toast or plain. It is necessary to add a little butter⁽²⁾ to the milk in boiling if skim milk is used. Cream sauce may be used in serving if desired.

(2.) Instead of boiling in milk. after draining off the first water add a little piece of butter or bacon⁽²⁾ and then cover the shoots with cold water, season with salt and boil for 5 minutes. Drain and serve.

DASHEENS AS STOCK FEED.

Although extensive feeding experiments with the dasheen have not yet been made, as a stock feed it is probably equal in value to the potato, sweet potato or cassava. For this purpose, however, as with potatoes and sweet potatoes, dasheens, will in general, be used only incidentally, as in cases of overproduction or of dasheens unsuited in size or quality for market. They seem, in the raw state, to be more palatable to stock than potatoes and, while doubtless less palatable than sweet potatoes, they contain a higher proportion of protein to starch and sugars than sweet potatoes. Both cattle and hogs eat them with relish after getting the taste, and pigs 8 months old have been fattened for the market in a month by turning them in the autumn into a patch of dasheens.

CULTURE OF THE DASHEEN.

PLANTING.

Dasheens are adapted for commercial culture only in the Southern States. They require a frostless season of at least seven months, with plenty of moisture, to fully mature a good crop. For a large crop of good quality the dasheen must be grown in a moist but well-drained rich sandy loam. The addition soon after planting of a fertilizer containing 8 to 12 per cent. of potash, even in good soil, as a rule has a beneficial effect on the crop. A large proportion of either clay or muck in the soil produces strong-flavoured or tough dasheens, which often are quite unfit for table use. However, those grown in muck soil yield heavily and are reported to be entirely satisfactory for stock feed.

Planting is done in February in Southern Florida and as late as the early part of April in South Carolina. Whole tubers are used and are planted singly, 2 to 3 inches deep. Tubers weighing 3 to 5 ounces each are better than smaller ones for planting, although the character of the soil and the amount of moisture present are much more important factors than the size of the tubers.

In rich soil about 12 square feet is allowed for each plant, the spacing being 4 by 3 or 3½ by 3½ feet. This permits horse cultivation with the ordinary farm implements.

(1) The change from hot water to cold milk or water when the shoots are nearly done is to keep them from becoming too soft.

(2) The butter fat of the milk, or the bacon fat, appears to assist in destroying the acidity.

Recently the dasheen has been found to be subject to the common root-knot⁽¹⁾ disease of the South, which attacks many cultivated plants and weeds. The effect of the disease is to reduce the yield of dasheens. The spread of root-knot in dasheen culture is largely controlled by reserving for seed the tubers from selected, healthy plants only and planting in land that is free from infection.

HARVESTING.

The digging of dasheens for home use can usually begin in the middle of September and the main crop be harvested at any time after the last of October. The digging can be done with a spade, or when the area is large enough to warrant it the plants can be turned over with a plow. When the dasheens are to be stored or shipped, the soil is shaken from the clumps as soon as possible after digging. The clumps are then left on the surface of the ground in the field for two to four days to dry. The tops and feeding roots are then broken from the corms and tubers.

In localities where autumn frosts are severe, harvesting should be done before they occur, as the corms and tubers are likely to be injured if exposed to frost after digging.

STORAGE.

When dasheens have dried sufficiently in the field and are stored, free from soil, in a covered but well-ventilated place, they usually keep well. It is better not to store them in large piles, but to spread them out so that the air can circulate rather freely among them. There are several rots⁽²⁾ that are likely to attack dasheens in storage, or even while on the ground, if the dasheens are left lying in the field too long after digging or otherwise are improperly handled in harvesting or storing.

The fibrous covering of dasheens in the field seems to enable them to withstand for a short time temperatures several degrees below freezing before digging, but a temperature in storage even as low as 41° F., if prolonged for several weeks, has been shown to be very injurious to them. The results of experiments indicate that where the storage temperature can be controlled, temperatures in the neighbourhood of 50° F. are better than lower or much higher ones.

SHIPPING.

The dasheen is a good shipper, and as the railroads of the country have co-operated with the department so far as to place the new vegetable on the same footing as the potato in freight classification, shipment in barrel lots to most eastern and northern points is entirely practicable. The same protection against cold should be given dasheens in transit as is given potatoes.

(1.) Byars, L. P. A nematode disease of the dasheen and its control by hot-water treatment. *Phytopathology*, vol. 7, No. 1, January, 1917.

(2.) Harter, L. L. Storage-rots of economic aroids. *Jour. Agric. Research*, U. S. Dept. of Agriculture, vol. 6, No. 15, July 10, 1916, pp. 549-572.

The department is glad, so far as possible, to direct intending purchasers of dasheens to the most convenient commercial sources of supply.

CONCLUSION.

The dasheen is a recently introduced root crop, well adapted for culture in the Southern States. It is very similar to the potato in its food characteristics, but contains a higher percentage of nutritive material than that vegetable, owing to its lower water content. The flavour is delicately nutty. The crop matures in the autumn, when potatoes have to be shipped from the North, and is a good keeper. There seems to be no reason to doubt, therefore, that in time it will become firmly established in southern agriculture and be a welcome addition also to the limited list of starchy vegetables at present found on northern markets. Dasheens are easily shipped and the freight rates are no higher than for potatoes. The successful establishment of the dasheen industry means a new and valuable food crop for the Nation as a whole and at the same time an additional source of income for the South.

RECIPES FOR COOKING DASHEENS.

THE following notes are taken from a recent publication of the United States Department of Agriculture :—

If uncooked dasheens are scraped they should be handled in water to which sodium carbonate (washing soda) has been added—a level teaspoonful to the quart. This prevents the stinging irritation to the hands that often arises from the action of the acrid juice of the outer layer of the raw dasheen when mixed with water. This irritating property is destroyed by cooking. In ordinary paring, most persons do not find it necessary to use the soda.

The following recipes, suggested by various experts in cooking, have been put into their present form after being thoroughly tested. However, they are not regarded as being necessarily the best possible, and suggestions from anyone will be welcomed.

BAKED DASHEENS.—In baking dasheens a moderately quick oven is required. Do not bake so quickly nor so long as to char the outside. The time required for cooking dasheens is usually a little less than that for potatoes of the same size; those weighing more than a pound may be cut in half from top to base before cooking. The dasheens may be (1) baked in the skin, or (2) scraped, though it is generally better to bake in the skin.

1. For baking in the skin, clean the dry dasheens, by pulling off the loose fibre or by rubbing it off with a brush or cloth. Small tubers, especially if very dry, should be soaked in water for a few minutes before placing in the oven. Corms and large tubers should be parboiled; place in nearly boiling water, and boil from 10 to 20 minutes (corms freshly dug split open if boiled longer than 10 minutes). As parboiling reduces the time required for baking, there need be no waste through the

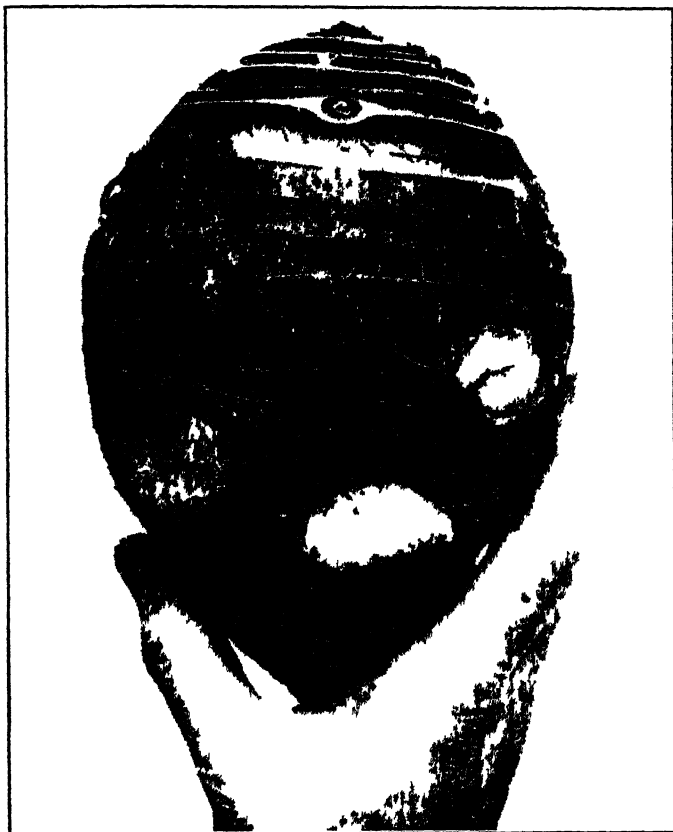


FIG 1—A TYPICAL CORM OF THE TRINIDAD DASHEEN

The cooked dasheen in texture and flavor is between the chestnut and the potato. The dasheen contains about half again as much protein and half again as much starch as the potato and is consequently much drier. The corm here shown weighed 34 pounds. The rings around the corm are the leaf scars and the large light spots on the lower half are the scars formed by breaking off the side tubers. Some corms are more nearly spherical and others are more elongate depending upon the soil and weather conditions and the length of the season.

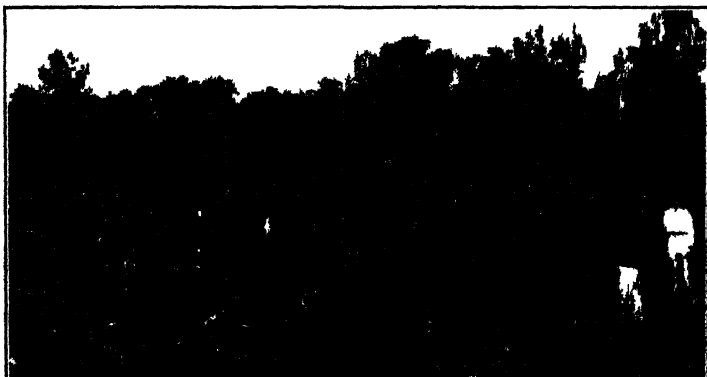




FIG 3.—DASHEEN CORMELS OR "TUBERS "

Tubers of the grade here shown are about two-thirds natural size and are referred to as first-grade tubers. With many of smaller size or irregular shape, they grow clustered around one or more large corms. Under proper soil conditions they are of excellent quality and command a much better price than the smaller and irregularly shaped ones.



FIG 4. TWENTY-THREE POUNDS OF DASHEENS, THE PRODUCT OF A SINGLE HILL.

In the center are five marketable corms, having a total weight of 11½ pounds. Most hills, however, produce only one or two large corms each. At the left are eight first-grade tubers, which weighed 2½ pounds, making a total of 14½ pounds of first-grade marketable dasheens. In the pile of tubers on the right some are of size and shape good enough to be classed as second-grade for market. The remainder are suitable for home table use, for planting, or for stock feed.



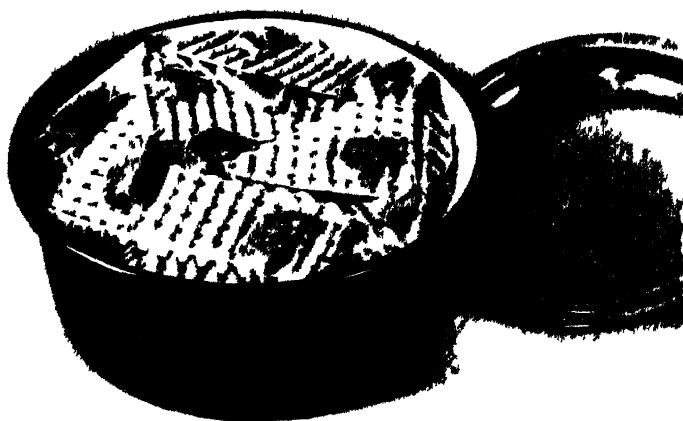


FIG 6—A CASSEROLE OF SLICED DASHEEN BUTTERED WHICH WILL BE READY FOR SCALLOPING AFTER THE ADDITION OF MILK

Dasheen corms or tubers are peeled raw and sliced with a fluted vegetable slicer. The cooking of this dish requires only a little more than half as long as scalloped potatoes. When well prepared it is one of the most satisfactory dishes made from the dasheen. Plum slices instead of lattice work may be used.

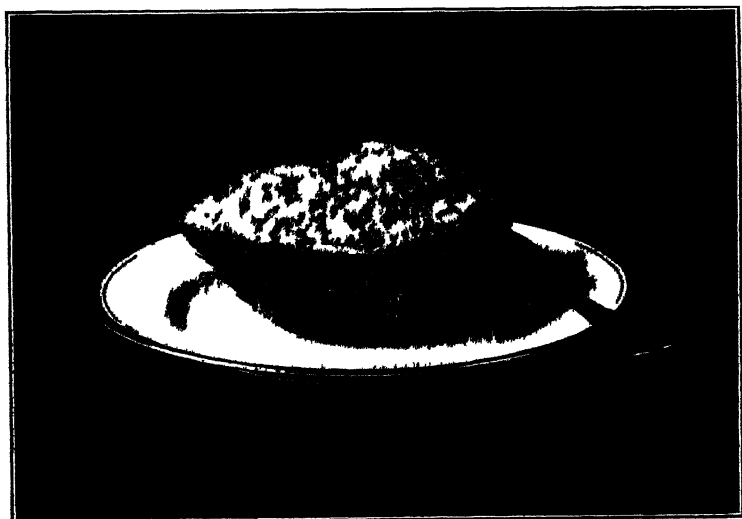


FIG 7—STUFFED DASHEEN IN THE HALF SHELL FOR INDIVIDUAL SERVICE

In preparing stuffed dasheens the corm is cut from top to base and baked the contents are then removed seasoned and returned to the half shells. A half of a large corm will serve two or more persons.

By Courtesy U. S. Dept. of Agriculture.

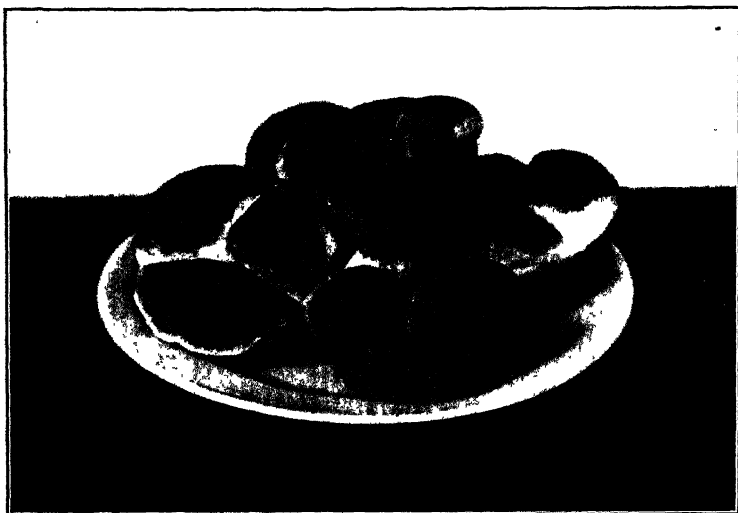


FIG. 8.—ROLLS MADE FROM WHEAT FLOUR IN COMBINATION WITH BOILED DASHEEN.

Bread made in this way is similar to that made with boiled potato in that it keeps moist longer than when flour alone is used. The bread is sometimes a little darker because of the dasheen, but the flavor is in no way impaired. One part of dasheen to two or three parts of flour gives excellent results.



FIG. 9—A BED OF FORCED AND BLANCHED DASHEEN SHOOTS, FROM WHICH THE COVERING HAS JUST BEEN REMOVED.

In forcing and blanching dasheen shoots, corms weighing 2 to 4 pounds are planted in a bed of moist, very sandy soil, and the bed tightly inclosed above with boards or other material to exclude light. Out-of-doors some mulching material such as straw, or even sand, may be used. The shoots are delicate in flavor and texture, the flavor suggesting that of mushrooms.

forming of a hard crust. When done, *serve immediately*. Season with salt and plenty of butter; add pepper if desired. Gravy may be used in place of butter.

Baked corms may be served in the "half-shell"; place a piece of butter in a hole made in the centre of the cut surface. Small half corms may be served as individual portions.

2. In scraping dasheens, as previously stated, they should be handled in water containing sodium carbonate (washing soda)—one teaspoonful to the quart. They may be cooked in one of three ways: (1) roasted with meat; (2) rubbed with fat and baked; (3) immersed in nearly boiling water long enough to heat through, and baked. With the last two methods a particularly delicious soft crust is formed, provided the dasheens have not been baked either too quickly or too long. Serve immediately.

BOILED DASHEENS.—Either large dasheens (corms) or small ones (tubers) may be used for boiling. They should be boiled in the skins, and may be served thus or with the skins removed. Dasheens need not be cooked quite so long as potatoes of the same size. They are, in fact, made less palatable by prolonged boiling; it is well to test with a fork or knitting needle.

The small tubers are especially good if, immediately after being boiled and peeled, they are placed in the oven just long enough to melt a dressing of butter over them. When so prepared, if kept in a warm place, they are less likely to become soggy from standing. Instead of placing them in the oven the tubers may be fried slightly, either whole or in halves.

It is usually better during the autumn and early winter to parboil the large dasheens (corms) for only 10 minutes, and then bake, as the corms split open and become water-soaked if cooked entirely by boiling at any time within a month after they are dug.

RICED DASHEENS.—Boil (or parboil and bake) the dasheens in their skins. Remove the skin immediately, rice the dasheen into a heated dish; and proceed in one of the following ways:

(1.) Stir in the desired seasoning, as butter and salt, and serve in a warm covered dish. The butter may be omitted if gravy is to be used, (Milk or cream may be beaten in if desired, as for mashed potato; but Dasheens prepared in this way will be rather sticky. Mashing in the ordinary way is not recommended.)

(2.) Empty the riced dasheen in layers into a warmed serving dish; season each layer. Do not stir.

(3.) Season the riced dasheen as desired and put into a baking dish, with a liberal quantity of butter on top. Bake for 8 or 10 minutes and serve.

In ricing dasheens the round or plunger type of ricer rather than the triangular, lever type should be used. One with wrought-iron handles is better than one with cast-iron handles, as the latter are too easily broken.

STUFFED DASHEENS.—Proceed the same as in baking; and, when the dasheens are done, follow the method used for stuffed potatoes, using more butter, however. If moistened with cream, instead of milk, still better results are secured.

The corns are especially adapted for serving in this manner; they may be scraped or simply scrubbed, as preferred: and, unless much smaller than a pound in weight, they may be cut in half,—always from the top to the base. Instead of mashing dasheens it will always be found better to rice them with a potato ricer or rub them through a coarse sieve. If, after baking, the upper part of the corn is found to be hard, this part should be taken out and discarded.

SCALLOPED DASHEENS.—Pare and slice raw dasheens, putting the slices in layers into a buttered baking dish, and seasoning each layer with butter, salt, etc. A few thin slices of onions added brings out the dasheen flavour. Latticework slices of dasheen, made with a fluted slicer, are a little more attractive in appearance than the plain ones, and they do not mat together. Nearly cover with rich milk, and bake. Scalloped dasheens require only about two-thirds as much time in cooking as scalloped potatoes. When corns are used for scalloping, it is well to discard about three-quarters of an inch of the upper, or bud end, as it may be tough after cooking. On account of the firm texture of the dasheen, a slicer with the sliding guard made of wood, rather than of tin, is desirable if a fluted slicer is used.

This method of serving the dasheen will be found particularly well adapted for banquets or formal dinners; and in such cases individual baking dishes or casseroles should be used if practicable.

DASHEENS AU GRATIN.—Proceed as for scalloped dasheens, but use less butter and add grated cheese. Bread crumbs may also be added to the top layer.

DASHEEN CRISPS.—Dasheen crisps are especially recommended. They are made by cutting the raw dasheens into latticework slices, as for scalloped dasheens, or into fluted slices, and frying slowly to a straw colour in deep fat. Drain on clean paper, and salt immediately. It is well to soak the sliced dasheens in water for an hour or so, and dry them between cloths, before frying.

DASHEEN SARATOGA CHIPS.—Dasheen Saratoga chips are made in the same way as potato chips. Pare raw dasheens, and if the outside has become wet with water, dry them; slice about one-sixteenth inch thick, soak in plenty of water for from one to two hours, changing the water once, and dry the surface of the slices between cloths. Fry in deep fat to a straw colour. Place the chips on clean paper so that the excess fat may be drawn from them. Salt immediately when taken from the hot fat.

FRIED DASHEENS.—Slice boiled dasheens, either warm or cold, season with salt, and fry quickly in plenty of fat. If fried too long they become dry and hard.

French-fried dasheens are also exceedingly good. Care should be taken to see that they are not fried too long.

Boiled dasheens, while still hot, may also be mashed or put through a potato ricer, mixed with grated cheese, made into cakes or croquettes, and fried. The cheese may be omitted and the croquettes dipped in egg and cracker crumbs before frying.

DASHEENS GRIDDLECAKES.—Excellent griddlecakes are made by using one part of grated raw dasheen to one, two, or three parts of wheat-flour, with the other ingredients as usual.

DASHEEN FRITTERS.—1 cup of grated or finely ground raw dasheen 1 cup of white flour. 1 tablespoonful of sugar, $\frac{1}{2}$ teaspoonful of salt, 2 teaspoonfuls of baking powder, $\frac{1}{2}$ cup of milk.

Mix the dasheen and the dry ingredients, and add the milk. Drop heaping teaspoonfuls into deep hot fat and fry to a golden brown. Sprinkle with powdered sugar, and serve immediately; or serve with maple or sugar syrup. These fritters make one of the most thoroughly delicious of all dasheen dishes.

CREAMED DASHEENS.—Boil the dasheens in the skin and proceed as for creamed potatoes.

DASHEEN SALAD.—Boil medium-sized or small dasheens in the skin and proceed as for potato salad. The addition of onion improves the salad. It is very important to prepare the dasheens while still warm and to add the dressing at once.

DASHEENS AS FILLING FOR FOWL AND OTHER MEATS.—2 cups of riced dasheen, 1 cup of bread crumbs, 1 egg, 2 tablespoonfuls of butter. season to taste with salt, pepper, sage and onion.

The dasheen should be boiled and riced in the usual way. They make a particularly delicious filling, comparable with that made with chestnuts.

DASHEEN SOUP.—3 cups of boiling water, 3 cups of milk. 3 cups of riced dasheen, 8 tablespoonfuls of butter. Salt and celery salt to taste. Parsley or grated onion if desired.

Boil and rice the dasheens as described. Into a double boiler put the boiling water, and add the milk and dasheen. Bring to boil and cook for 5 to 10 minutes. Season and serve.

CANDIED DASHEENS.—Peel parboiled dasheens and cut into thick slices or strips. Prepare a syrup made in the following proportions:

1 cup of sugar, 2 cups of hot water, 2 to 3 tablespoonfuls of butter. Salt to taste.

Either granulated or brown sugar may be used. Cinnamon may be added if desired. Boil in this syrup in a covered dish until soft, and brown in the oven.

This dish is very similar to the candied sweet-potatoes so commonly served as one of the vegetables to accompany roast meats and fowl.

DASHEEN BREAD.—Make the bread in the usual way; but replace one-fourth or one-third, by measure, of the wheat flour with boiled and riced or mashed dasheen. The dasheens should always be boiled in the skin. The bread, which is much like that made with potato in a similar way, is usually a little darker than when made from all wheat; but the texture and flavour are excellent, and the bread does not dry out so quickly.

DASHEEN PIE.—Any recipe for sweet-potato pie will probably do, but the following is suggested as being economical and otherwise satisfactory. The dasheens should be boiled and riced as usual.

2 cups of riced dasheens, $\frac{1}{2}$ cup of butter, $\frac{3}{4}$ cup of white sugar, $\frac{1}{2}$ teaspoonful of cinnamon, $\frac{1}{2}$ teaspoonful of nutmeg, 1 egg (white and yolk beaten separately), 2 cups of milk, $\frac{1}{2}$ lemon, juice and rind.

Bake in a deep pie tin. Serve warm.

DASHEEN PUDDING.—Proceed the same as with the above recipe for pie. Bake without crust in a deep dish well buttered.

CACAO.

CACAO IN ECUADOR.

By J. B. RORER, M.A.,
Mycologist, Board of Agriculture.

I REACHED Guayaquil on November 16, 1917 but owing to a revolution which was going on I was unable to visit the main cacao-growing districts until early in December, after the chief of the revolution had been captured and imprisoned. During the month of December I was able to visit a number of large cacao estates, especially those which were affected by serious diseases.

All the estates in Ecuador are very large, some having as many as three million trees, while the smallest have at least 250,000 to 350,000. There are no peasant proprietors owning small plantations. In the coast region where the cacao is grown all the land is in the hands of very rich persons.

Very little has ever been done in the way of cultivation. In fact, many of the estates are planted through the forests. In other places no shade whatever is used. The trees are planted very close, the distance varying from 6 to 9 feet. The soil is very rich and the trees make a very vigorous growth. No lateral branches are allowed to develop until a height of about 20 feet is reached, and in many places from 8 to 10 suckers are allowed to grow up with the main tree. Naturally the estates are very dark and no brushing is necessary—in fact it is impossible for anything to grow in the dense shade under the cacao trees. When the trees get old the tall slender stem cannot support the weight of the crown of leaves and begins to bend. Eventually all the trees become interlaced overhead. The yield per tree on good estates I was told was about one pound of dry cacao.

The greater part of the cacao cultivation of Ecuador is quite free from disease; however, in districts along the foothills of the Andes where the climate is very damp, two fungous diseases have crept in and are now doing a great amount of damage in some places destroying as much as 95 per cent. of the crop every year. These two diseases are quite new and have never been recorded from any other cacao-growing country. One is a disease of the fruit alone, while the other attacks both fruit and tree, but does the greater damage to the latter, causing a canker somewhat similar to that which we have in Trinidad. This disease is very serious on what we call Venezuelan cacao of Ecuador but which is nothing more or less than the ordinary Trinidad Forastero, which was introduced into Ecuador some little time ago. This variety is a much more delicate tree than the so-called Nacional, which is almost universally grown through Ecuador. Many persons, however, are planting the Venezuelan variety because it bears more heavily, but if they are to succeed the entire system of planting will have to be changed.

As I said in the beginning, very little had been done in the way of cultivation, partly because it has been possible to grow cacao without any care, and partly because of the very heavy export tax put on cacao by the Government,—this tax amounts to something over \$8 per 100 pounds.

Cacao is not fermented at all but is spread out on dry floors as soon as it is brought from the field. Each night, however, it is swept into piles and covered, when of course a certain amount of fermentation does take place. The best grade of Ecuadorean cacao is a very pretty product, the beans being a very light golden yellow in colour and of a fairly large size. The methods of drying are rather primitive.

I am quite sure that the fungous diseases can be controlled, but of course it will be necessary to carry out certain experiments to prove this. I have embodied the study of these diseases and the recommendations for their control in a report which was presented to the Asociacion Agricultoras del Ecuador, which has been translated into Spanish and will be distributed for the benefit of the growers there.

AGRICULTURAL EDUCATION.

TOBAGO PRIZE COMPETITIONS, 1917.

THE Board of Agriculture offered the following prizes for competition in Tobago :—

- CACAC— Class 1. Ten acres with at least five in bearing—\$25.00, \$15.00, \$10.00.
 Class 2. Under ten acres with at least two in bearing—\$15.00, \$10.00, \$5.00.
- Tobacco— Class 1. Best quarter acre or more—\$15.00.
 Class 2. One-eighth to one-quarter of an acre—\$6.00, \$4.00, \$2.00.
- Vegetables—Class 1. Half an acre of plantains, tannias or cassava or corn—\$8.00, \$4.00.
 Class 2. Half an acre of sweet potatoes, cassava, and black-eye peas or corn—\$10.00, \$5.00, \$3.00.
 Class 3. Quarter acre of yams (not less than four varieties) and corn—\$10, \$5.00, \$3.00.

No prizes to be awarded unless there were ten competitors in each class.

The work was put under the charge of Mr. F. D. Davies, the resident Agricultural Adviser, who visited the holdings of the competitors throughout the year and gave them practical advice on how to improve their cultivation.

After a preliminary selection by Mr. Davies the judging was done in January, 1918 by Mr. W. E. Broadway and Mr. Davies. The prizes were distributed at public meetings at Roxburgh and Scarborough on March 27 and April 2 by Mr. W. G. Freeman, Acting Director of Agriculture. The following extracts are taken from the Judges' report :—

CACAO.

CLASS 1.—TEN ACRES WITH AT LEAST FIVE IN BEARING.

Ten competitors were selected for judging in this class, three of whom withdrew at the last moment. After carefully going through the seven fields remaining, we beg to say that Charles Dann, James Taylor and Robert Douglas have proved themselves very good workers, while John Franklin and James Archer bid fair for the future. We feel sure that Archer would have been a hard competitor to beat, but unfortunately, was handicapped by having to bury three children in one month quite recently.

Charles Dann has worked assiduously for his position on the list. His field is a picture of neatness and intensive cultivation. His forking, manuring, draining, road making, judicious pruning and thinning of shade, his manure shed and the very keen way of answering all the questions put to him, his up-to-date curing house to which he has had to add considerable space recently, prompts us to say that he deserves all the credit we can give him.

James Taylor has also plodded hard and intelligently from the beginning, so that he too is to be highly commended for all his good

work, especially with regard to forking, manuring and weeding, and also in the purchasing of four cows which he has kept at stake for making manure on every convenient ridge in his field, and finally in the strong determination to win a prize. His work in general is excellent.

1st Prize—Charles H. Dann, Pembroke, 12 acres ... 93 marks.

2nd „ James Taylor, Parlatuvier, 15 acres ... 95 „

3rd „ R. Douglas, Merchiston, 11 acres ... 90 „

CLASS II.—UNDER TEN ACRES, WITH AT LEAST TWO IN BEARING.

This class appears to be the most keenly contested of all. Eight competitors were judged and all have done good work.

Herbert Dann and Charles E. McPherson were responsible for excellent work. Dann's contour draining, road making, mulch pits and intensive manuring, are of special merit, while McPherson's sanitation, draining, manuring and forking may be justly referred to in similar complimentary terms.

Adolphus Hector has done well, and has it to his credit for growing cacao successfully without shade, a system which is being rapidly followed in Tobago.

The judges commended the work of Leoni Hercules and Samuel Muir who tied for fourth place in the list.

1st Prize Herbert Dann, Pembroke, 5 acres ... 99 marks.

2nd „ Charles McPherson, King's Bay, 5 acres ... 98 „

3rd „ Adolphus Hector, Lower Retreat, 7 acres ... 91 „

Commended Leoni Hercules, Merchiston, 5 acres ... 89 „

Samuel Muir, Pulteney Hill, 8 acres ... 89 „

VEGETABLES.

CLASS I.—HALF ACRE OF PLANTAINS, TANNIAS OR CASSAVA AND CORN.

Eight competitors entered in this class for judging. The work on the whole has been good, but of the two prize winners, we make a few remarks owing to their work being of exceptional merit.

Claudius Baptiste, who comes first, has half an acre of land planted in plantains, tannias, dasheen, corn, blackeye peas, French or salad beans and red beans. The land has being cleared and forked, manured broadcast with pen manure and then banked or hilled with the hoe. In the banks are planted the tannias (each bank three feet apart) and slightly inclined to the back are the beans. Between each bank the blackeye peas are planted, and corn four feet apart in the furrows, which are well forked. Holes are dug for plantains twelve feet apart, each whole being two feet deep, and two feet wide. The land being on a slight incline, blind contour drains are dug 24 feet apart to conserve moisture. His work is excellent.

Herbert Dann has planted cassava instead of tannias. The land is thoroughly lined, forked and manured. Holes 14 feet apart, are dug two feet square for cacao and plantains; the plantains are planted and alternate rows of cassava and corn, each row being three feet apart, and each crop planted three feet in the rows. The plantain and cacao holes are all filled with well rotted pen manure, but the cacao are not planted until four months after. The field shows the value of this work. Contour drains pass through the whole field, from boundary to boundary.

1st Prize Claudius Baptiste, Lower Retreat ... 98 marks.

2nd „ Herbert Dann, Pembroke ... 94 „

CLASS II.—HALF-ACRE OF SWEET POTATOES, CASSAVA AND BLACK-EYE PEAS OR CORN.

Eleven competitors were judged in this class, and all have done good work. The first six, however, are by far, superior.

Robert Douglas has done excellent work. His land having been brushed, he started from the bottom with hoe and fork to make his rows or banks. This system is known in some places as "trenching forward." All weeds, &c., are placed in the furrows, and the rows made on them, each row being three feet apart. Slightly to the back of the bank cassava is planted three feet in the row, and black-eye peas between the cassava. Corn is planted at the same distance in front and potato cuttings twelve inches long are planted twelve inches apart in the centre of the row. About eight inches of the cutting are buried, and as the centre of this portion is buried deepest, it forms nearly a half circle; great care is taken to select good cuttings. Contour drains are dug, thirty feet apart, to conserve water and to prevent soil wash.

John Franklin and Adolphus Hector have also done admirably as well as Prince Stewart, Leoni Hercules and Thomas Hector.

[The judges commended the very good work carried out by Prince Stewart, who came next to the third prize winners with a difference of one mark, due to his being taken ill just before completing his plot.]

1st Prize—Robert Douglas, Merchiston	... 98 marks.
2nd „ John Franklin, Goodwood	... 97 „
3rd „ Adolphus Hector, Lower Retreat	... 94 „
Commended—Prince Stewart, Sherwood Park	... 98 „

CLASS III.—QUARTER ACRE OF YAMS (FOUR VARIETIES) AND CORN.

Owing to a scarcity of yam plants at the time of starting the competition only eleven competitors were entered. Of these six were selected for judging, one of whom did not turn up to meet the judges.

Of the five judged, Leoni Hercules comes first, while R. Douglas and S. Carrington took first and second places, respectively, all having done very good work. S. Carrington is to be highly commended for his determination to show his district (Charlotteville) that he could win a prize and get it from the Board.

L. Hercules has in his garden seven varieties of yams, planted up in a little more than a quarter of an acre. Starting from the bottom of his plot, his banks were systematically made three feet apart; each furrow was forked, all stumps and roots taken out, weeds and manure placed in the furrow and the banks made on them. The uniformity of his work on the whole, *i.e.*, draining, staking and separating each variety, commands our highest praise. We have pleasure in saying, also, that at the Windward District Agricultural Society's Show held in Roxborough a few days after the judging, this competitor won the first prize for the best twenty pounds of yams and first prize for the best collection of six varieties, proving clearly that quality and cultivation go hand in hand.

1st Prize—Leoni Hercules, Merchiston,	95 marks.
2nd „ —Robert Douglas, Merchiston,	91 „
3rd „ —Shadrack Carrington, Charlotteville,	80 „

TOBACCO.

CLASS I: BEST QUARTER ACRE OR MORE.

Owing to the fall of this Industry due, apparently, to the lack of a remunerative market within the past seven months, only two of the forty competitors, entered, kept their fields in condition for judging.

As these competitors fall in Class I, where only one prize is offered, and taking into consideration the high marks obtained, we recommend that the prize be divided, giving ten dollars (\$10.00) to George McCall and five dollars (\$5.00) to Edith Forbes.

1st Prize—George McCall, Scarborough ... 92 marks.

2nd Prize—Edith Forbes, Scarborough ... 91 marks.

CLASS II: ONE-EIGHTH TO ONE QUARTER ACRE.

[There were no plots to judge in this class].

REPORT ON THE RICE PRIZE COMPETITION, 1917.

THE prizes were presented to the winners in this competition by His Excellency the Governor at the meeting of the Board of Agriculture on May 28, 1918.

The instructional work through the year was done by Mr. C. M. Roach, Agricultural Adviser and Mr. L. A. Brunton Assistant Superintendent of Field Experiments, has co-operated with him in the judging. The following is a summary of their report:—

We have the honour to report on the results of our judging of the 1917 Rice Competition. We began judging at Fyzabad on Friday, November 2, and closed at Caroni on Friday, December 28. The curing of samples occupied some time after the field work had been completed.

Scrupulous care was exercised in examining the competitors to ascertain their respective knowledge of the various operations incidental to Rice Culture and in the selection and cutting of the "samples." We should explain that the paddy reaped from one square yard of "dhan" (1) at the apparently best spot in a field constituted a "sample." From these samples the "best" yield per acre was calculated and from this an "ordinary" yield was estimated by division into two.

The outstanding feature of the results is the perplexing inconsequence of the figures. (a) Poor soils of one district have given heavier yields than richer soils of another. (b) Similar soils have given widely different results under apparently similar treatment. (c) The same strain of rice has given, from causes to us obscure, very different returns in the same district and under apparently like conditions. (d) No direct consequence can be positively traced to even any cultural operation save

(1) *i.e.* Standing rice.

in a slight measure "care of plants" as will appear from a glance at the extract below.

District.	Marks gained for care of plants.	Strain of Rice.	Best yield per acre.	Remarks.
			bags of 160 lb.	
Fyzabad	8	Chittagan ..	92	The double sequence is remarkable. The Jinwah being a poorer yielder requiring in each instance a higher mark of "Care" than the last of the Chittagans. The 5th Chittagan is exceptional.
	7	" ..	43	
	4	" ..	38	
	7	Jinwah ..	36	
	4	Chittagan ..	27	
	6	" ..	24	
	3	" ..	23	
	6	Jinwah ..	20	

RESULTS OF COMPETITION.

DISTRICT A (OROPUCHE AND SOUTH NAPARIMA).

Of a total of 176 entries for this competition 17 came before the judges. Two of these were disqualified for insufficiency of acreage and one was not marked as his work was entirely below the standard already set up.

Looking through the results the paucity of striking features is disappointing. The rapid fall in the totals of points gained by the competitors is worthy of remark, however, there being a drop of 29 marks between the first and third places. The only real striking feature of the results is the information gained concerning the yielding capacity of a square yard of land. This has been ascertained to be as high as 46 ounces avoirdupois "dhan" ⁽¹⁾ which gives a yield per acre of 92 bags paddy of 160 pounds each.

The average of the 14 "best" yields taken works out at 42 barrels per acre, and when this is halved for an "ordinary" yield we get 21 barrels per acre, which is just about the accepted average of the island. The correctness of our figures is thus demonstrated although at first glance some appear fabulous.

When we attempt however to work out any monetary deductions from the information collected we are baulked at every turn by conflicting figures. For instance: Although "Chittagan" rice has produced the highest individual yield—a wonderful one—yet its average of 42 barrels is below that of "Soro" which is 54. The same inconsequence appears when "manures" and "soils" are considered as when "strains of rice." The only fact that has been fairly plainly defined is that the strains "Soro" and "Chittagan" yield better under a wider range of conditions than any other strains.

To restrict our remarks to the Competition proper: We are gratified to note that the interest displayed by many of the competitors resulted in a healthy rivalry, and were it not that the large number of entries and

(1) Here used in the sense of paddy i.e. unhusked rice.

the wide and difficult areas over which the competitors were scattered precluded any but sketchy coaching by the Agricultural Adviser a much higher standard of work would in all probability have been attained. The averages of points gained in the two main branches of the Cultivation by the first six competitors are 72 per cent. in tillage and 77 per cent. in Water Control, which is very creditable. The average of the Prize Winners' totals is 77 per cent., also a very satisfactory figure.

We have much pleasure, therefore, in recommending that the prizes as advertised be awarded to the first three competitors namely:—

1st Prize, \$20—S. M. Harnarain, Fyzabad	... 93 marks.
2nd „ \$10—Bukharan, Fyzabad	... 74 marks.
3rd „ \$ 5—Bularie, Débé	... 64 marks.

DISTRICT B (BEJUCAL-CARONI).

There were in all 53 entries for this competition but only 6 competitors came before the judges.

The spirit of competition was not so keen in this district as in district A and many of the most promising dropped out altogether for little or no apparent reason. No competitor has attained even a two-thirds proportion of points and only two have gained over 50 per cent.

Under these circumstances, we do not feel able to recommend that the first prize be awarded, but suggest that the 2nd and 3rd prizes only should be awarded to the first two competitors.

1st Prize—Not awarded.

2nd „ C. C. Abidh, Charlieville	... 60 marks.
3rd „ Ramdor, Caroni	... 52 „

In conclusion, we beg to remark that the Competition has been of undoubted advantage to the Rice Industry, and the importance of this industry to the Colony and the Empire requires that the advantage be followed up closely.

(Sgd.) L. A. BRUNTON.
C. M. ROACH.

February 2, 1918.

REPORT ON THE RICE SEED IMPORTED FROM DEMERARA.

Concerning the paddy imported from Demerara for distribution to Rice growers for seed purposes: I beg to report that in over 100 trials, only two favourable results can be recorded.

The first consignment of seed was evidently "old" and was badly infested with weevils. Not more than about 15 per cent. germinated. These grew weakly and where the water supply was at all poor the plants began to develop a "leaf-spot blast" before they were fit for transplanting. Where water was fairly abundant [during early stages the plants grew fairly well and fruited early, but an "ear blast" then came and ruined the crop.

One grower of Fyzabad, the winner of the first place in the competition, secured an average yield of 23 bags per acre. This grower was the only one to have a regular drain in his rice field and I attribute his comparative success to the fact that he could and did reduce his water supply after the grain had reached the "milk" stage. Every other

grower who tried this seed complained of having made the poorest crop on his record.

The second consignment of seed was superior to the first, but arrived so late that a fair trial cannot be said to have been given it. The facts are, however, that in the majority of instances, although making promising seedlings, which after transplanting flowered and seeded earlier than the earliest local strains by nearly a month, yet the same "ear blast" that attacked the other seed plants took hold of these also almost immediately after the grain had reached the "milk" stage, and reduced the crop to zero.

Local strains in close proximity to plots of these rices were slightly affected. I assign the chief cause of the failure of these rices to excessive moisture in the soil and air at fruiting time.

(Sgd.) C. M. ROACH.

February 2, 1918.

CANE FARMERS' PRIZE COMPETITION, 1918.

THE BOARD OF AGRICULTURE OFFERS PRIZES TO THE VALUE OF TWO HUNDRED AND THIRTY DOLLARS FOR THE ENCOURAGEMENT OF GOOD CULTIVATION OF CANES BY FARMERS.

RULES.

1. The following prizes will be given in each district:—

	<i>1st</i>	<i>2nd</i>	<i>3rd</i>	<i>4th Prize.</i>
<i>District.</i> —North Naparima ...	\$50	\$35	\$20	\$10
„ South Naparima ...	\$50	\$35	\$20	\$10

2. The competitions will be confined to the two Naparima districts.

No. 1.—North Naparima, bounded as follows:—

North—Hermitage and Caratal roads.

South—Naparima Mayaro road.

East—Mayo and St. Julien roads.

No. 2.—South Naparima, bounded as follows:—

North—Naparima-Mayaro road.

South—Line of the Oropuche Lagoon. Inverness, Realize and Mandingo roads.

East—Moruga road.

3. No farmer will be allowed to compete unless he has not more than five acres and not less than one acre in growing canes.

4. No prizes will be awarded unless there are at least 50 competitors in each district.

5. The competition will be for the period June–December, 1918. Entries will close on June 15, and the cultivation will be judged in December, 1918.

6. In judging, marks will be given under the following heads:—

(1.) Tillage (drainage, forking, round ridging, weeding, manuring, burying trash) ... 80 points.

(2.) General (varieties of canes and any special features) 20 „

7. The method of cultivation and nature of the soil will be taken into account by the judges.

8. The Board of Agriculture on the recommendation of the judges may withhold or alter the value of any or of all the prizes if the cultivations entered for competition are not considered of sufficient merit.

9. Due notice will be given before the judging commences, and the decision of the judges in all cases will be final.

Applications for Entry Forms should be made to the Agricultural Adviser at San Fernando or at the office of the Department of Agriculture, Experiment Station, St. Clair, Port-of-Spain.

ENTRY TO COMPETITION—FREE.

Entries may be sent free if addressed to—

The Agricultural Adviser, San Fernando, or

The Director of Agriculture, Experiment Station, St. Clair, Port-of-Spain.

THE BOARD'S ADVISER MR. O. M. ROACH, WILL VISIT ALL HOLDINGS ENTERED FOR COMPETITION, AND GIVE ADVICE AS TO THE BEST METHODS OF CULTIVATION, FREE OF ANY CHARGE.

RUBBER.

COMPARATIVE RESULTS OF THE GROWTH OF HEVEA, CASTILLOA AND FUNTUMIA RUBBER TREES AT ROXBURGH ESTATE, TOBAGO.

By JOSEPH DE VERTEUIL, F.I.C., F.C.S.,
Superintendent of Field Experiments.

In 1907, five plots of approximately one-fifth of an acre each, of old cane lands situated on the Roxburgh flats, were planted alternately in rows at a distance of 17 feet by 17 feet with twelve Hevea, Castilloa and Funtumia rubber trees respectively.

From 1911, when the trees were about 4 years old, the plots were treated as follows:—Plot 1, 7 tons pen manure per acre; plot 2, 2½ cwt. sulphate of ammonia and 1½ cwt. sulphate of potash per acre; plot 3, wild indigo (*Indigofera* sp.) was planted as a cover crop; plot 4 was mulched with the grass from an adjoining trace measuring 1,800 square feet or approximately one-fifth the size of the plot and plot 5 was kept as a control.

From 1915 the applications of manures and mulch have been discontinued as the rubber trees had shaded the ground to such an extent that the wild indigo in plot 3 had failed to grow in 1914.

The girth of the rubber trees was measured in March 1911 previous to manuring and thence yearly to April 1915 when manuring ceased. The average results has been published in the *Bulletin of the Department of Agriculture* XV. 1916, 143. The girth of the trees were again taken in December 1916 and the average results recorded with those of 1911 in the table below.

Average girth of Rubber trees 8 feet above the ground.

PLOT.	HEVEA.			CASTILLOA.			FUNTUMIA.		
	March 1911.	Dec. 1916.	Average yearly increase.	March 1911.	Dec. 1916.	Average yearly increase.	March 1911.	Dec. 1916.	Average yearly increase.
	In.	In.	In.	In.	In.	In.	In.	In.	In.
1	6.5	31.9	5.1	15.2	37.1	4.4	4.3	10.9	1.3
2	4.9	31.7	5.4	14.7	39.9	5.0	4.1	16.0	2.4
3	7.1	35.0	5.6	19.0	38.5	3.9	5.0	16.9	2.4
4	8.0	33.5	5.1	20.0	41.8	4.4	7.0	18.5	2.3
5	3.3	21.2	3.6	15.1	37.8	4.5	7.1	22.4	3.1

From this table it will be seen that:—

1. The Castilloa are the quickest and the Funtumia the slowest growing trees.

2. After manuring, the Hevea have made a better yearly growth than the Castilloa.

8. The Hevea have made their best growth in the plot where the wild indigo has been planted for shading the ground.

4. The Castilloa have made their best growth in the plot to which 2½ cwt. sulphate of ammonia and 1½ cwt. sulphate of potash have been applied per acre.

5. The Hevea have responded better to manuring than the Castilloa.

6. The Funtumia have made their best growth in the control or *no manure* plot.

7. The manures were of no benefit to the Funtumia, that no apparent advantage has been derived from manuring the Castilloa and that the Hevea have benefited slightly from the manual treatment.

A large number of Funtumia trees have died apparently from excessive rain. The average rainfall on the estate for the past 8 years (1909-1916) has been 94·72 inches.

Although the lands on which these experiments were made are described as old cane lands, it is not meant to infer that the soil had been exhausted by cropping. As a matter of fact the Roxburgh flats are very good lands as can be seen by the subjoined results of two samples analysed by me in 1909. The soil marked C had been limed about three months before the samples were taken and this is probably the cause of the increase in nitrates shown by the analysis; as it is well known that the lime assists nitrification.

Results of Analysis of Soils from Roxburgh flats.

				C.—Limed.	D.—Not limed.
Water ...	...	...	...	4·40	6·42
Organic matter and combined water	...	...	...	10·40	9·96
Mineral	...	...	...	85·20	88·62
				<u>100·00</u>	<u>100·00</u>

Composition of samples dried at 100° C.

Organic matter and combined water	...	...	10·879	10·648
Soluble silica	...	...	·725	·764
Oxides of iron and alumina	...	...	23·471	23·107
Lime	...	...	1·816	1·921
Magnesia	...	...	·795	·840
Potassium oxide	...	...	·246	·270
Sodium oxide	...	...	·113	·150
Phosphoric anhydride	...	...	·065	·156
Sulphuric anhydride	...	...	·081	·111
Chlorine	...	...	·004	·008
Insoluble silica and silicates	...	...	61·825	62·085
			<u>100·000</u>	<u>100·000</u>

* Containing—Total Nitrogen... .. 287% 229%

Available Plant Food.

Potassium oxide	...	...	·0074%	·0102%
Phosphoric anhydride	...	...	·0224%	·0462%
Nitrogen as nitrates	...	...	·0124%	·0046%

PLANT DISEASES AND PESTS.

THE COCONUT BUTTERFLY.

THE Coconut butterfly has been known to the writer since 1894 when a nest of the caterpillar was found at the Oocal just near the watch house, since then nests have been observed singly every now and then in different parts of the island. In 1908 Mr. Geo. F. Huggins called the attention of the Botanical Department to the Coconut butterfly caterpillars which were then attacking Royal palms in the sugar growing districts of Naparima. From 1909-1913 there were few observed. At the end of 1914 and the first half of 1915 the caterpillars appear to have been numerous in isolated localities on the east and west coasts. This state of affairs continued in the same places during 1916 and 1917; in the first quarter of 1918 a small outbreak occurred at Icacos. In January and February of this year there were still numerous nests to be found in the same places, but the natural enemies appeared to be gaining the upper hand. An account of the 1916-1918 outbreak is in preparation, but in the mean time particulars of the pest can be found in Circular No. 5 Board of Agriculture. As this pest has been proclaimed under the Plant Protection Ordinance it can be effectively dealt with. The following Proclamation was issued in March this year :

F.W.U.

TRINIDAD AND TOBAGO.

No. 87 of 1918.

By His Excellency Major SIR JOHN ROBERT
CHANCELLOR, R.E., K.C.M.G., D.S.O., Governor
and Commander-in-Chief in and over the Colony
of Trinidad and Tobago and its Dependencies,
Vice-Admiral thereof, &c., &c., &c.

[L.S.]

J. R. CHANCELLOR,
Governor.

A PROCLAMATION.

Whereas by Section 2 of the Plant Protection Ordinance, 1911 (No. 88 of 1911) as amended by Section 2 of the Plant Protection (Amendment) Ordinance 1916, it is among other things enacted that the term "Pest" includes any parasitical, epiphytal or other animal or vegetable organism and also any insect or other invertebrate animal, (in whatever stage of existence such insect or animal may be) affecting or injurious to trees, shrubs or herbs which the Governor may by proclamation from time to time declare to be a pest within the meaning of this Ordinance ;

Now, therefore, I, JOHN ROBERT CHANCELLOR, Governor as aforesaid, do hereby declare the Coconut Butterfly (*Brassolis sophorae*) to be a pest within the meaning of the said Ordinance.

The Proclamation, No. 28 of 1918 is hereby revoked.

Given under my Hand and the Seal of the Colony,
at Government House, in the City of Port-of-
Spain, in the Island of Trinidad, this 28th day
of March, 1918.

By His Excellency's Command,

S. W. KNAGGS,
Colonial Secretary.



METEOROLOGY.

RAINFALL RETURN JANUARY TO MARCH, 1918.

Stations.	January.	February.	March.	Total.	Total corresponding period 17.
<i>North-west District.</i>					
St. Clair—Royal Botanic Gardens ...	Ins.	Ins.	Ins.	Ins.	Ins.
Port-of-Spain—Colonial Hospital ...	3.15	1.18	1.48	5.81	5.61
„ „ Royal Gaol... ..	2.73	.84	1.55	5.12	2.38
„ „ Constabulary Headquarters ...	3.22	1.62	5.01	9.85	3.15
St. Ann's—Reservoir	2.91	1.50	1.36	5.77	2.63
Maraval— „ „ „ „	7.16	1.22	2.39	10.77	7.19
„ „ Constabulary Station	4.05	2.01	2.35	8.44	6.59
Diego Martin—Constabulary Station ...	2.13	2.30	2.59	7.02	7.65
„ „ Waterworks	4.31	1.83	1.47	7.63	8.91
„ „ River estate	8.67	1.42	1.33	6.42	7.31
Fort George Signal Station	4.03	1.46	1.31	6.80	7.27
North Post „ „ „ „	2.40	1.36	1.40	5.16	5.04
Carenage Constabulary Station	4.70	1.50	.87	7.07	5.78
Carrera Island Convict Dépôt	1.54	2.58	2.40	6.52	6.53
Chacachacare Lighthouse	1.64	.70	.22	2.56	3.42
„ „ „ „	5.55	1.22	.33	7.10	5.21
<i>Santa Cruz—Maracas District.</i>					
Santa Cruz—Constabulary Station ...	4.48	3.18	1.60	9.26	9.00
St. Joseph—Government Farm	3.46	1.43	.64	5.53	3.87
„ „ Constabulary Station	1.72	1.11	.38	3.21	3.52
Tunapuna—St. Augustine estate	2.58	1.07	.52	4.17	3.08
Maracas—Government School	5.71	3.04	2.51	11.29	8.51
„ „ Ortinola estate	3.35	3.06	1.37	7.78	7.57
„ „ San José estate	3.88	1.63	1.30	6.81	...
Caura—Wardour estate	3.75	1.61	.69	6.05	5.37
<i>West Central District.</i>					
Caroni—Frederick estate	3.97	.99	.58	5.54	5.12
Chaguanas—Constabulary Station ...	3.96	1.15	.55	5.66	3.40
„ „ Woodford Lodge estate	4.11	1.12	.43	5.66	3.35
Carapichaima—Waterloo estate	4.81	1.11	.58	6.50	3.89
„ „ McBean Cacao estate	3.90	.86	.59	5.35	2.95
„ „ Friendship Hall estate... ..	5.25	1.85	...	...	3.95
Couva—Exchange estate	2.66	.81	.30	3.86	1.66
„ „ Brechin Castle estate	3.92	1.07	.53	5.52	2.39
„ „ Perseverance „ „ „ „	3.07	1.01	.52	1.60	2.22
„ „ Camden „ „ „ „	3.69	...	...	...	2.02
„ „ Milton „ „ „ „	4.79	1.89	.05	6.73	3.68
„ „ Spring „ „ „ „	5.80	2.76	.07	8.63	5.68
„ „ Constabulary Station	3.31	1.17	.10	4.88	1.44
„ „ Esperanza estate	3.46	1.31	.15	4.96	2.11
<i>Montserrat District.</i>					
Brasso-Piedra—Mamoral estate	9.25	3.16	.90	13.31	7.85
„ „ La Mariana estate	7.31	2.82	1.16	11.29	6.82
Montserrat Constabulary Station ...	6.20	1.66	.48	8.31	3.60
Brasso—La Vega estate	6.79	2.89	1.31	11.02	5.32
<i>Arima District.</i>					
Arima—Warden's Office	4.22	2.00	.17	6.39	2.56
„ „ Torrecilla estate	5.83	3.42	.66	9.91	6.71
„ „ Verdant Vale estate	4.48	2.65	.57	7.70	5.77
San Rafael—Constabulary Station ...	8.06	3.92	1.76	13.74	7.92
Guanapo—Talparo estate	6.28	2.79	.98	10.05	7.60
„ „ San José Estate	7.43	4.19	1.73	13.35	8.87
Tamana—Sta. Marta estate	10.58	4.79	1.51	16.88	9.72
„ „ La Corona estate	8.18	4.03	2.12	14.33	10.72
<i>San Fernando & Princes Town District.</i>					
Claxton's Bay—Forres Park estate ...	5.30	1.47	.16	6.93	2.52
Pointe-à-Pierre—Bonne Aventure est. ...	3.91	1.88	.36	6.15	3.31
„ „ Concord estate	4.70	1.79	.55	7.04	3.78
„ „ Plein Palais estate	3.86	1.66	.35	5.87	3.27
Naparima—Picton estate	7.75	1.77	.47	9.99	2.91
„ „ Usine St. Madeleine	7.50	2.34	.74	10.58	2.87
„ „ La Fortunée estate	5.09	1.66	.32	7.07	3.23
„ „ Tarouba estate	4.53	1.68	.23	6.46	1.14
„ „ Union Hall estate	7.42	1.71	.75	9.88	2.94

RAINFALL RETURN—JAN. TO MAR., 1918.—CONTINUED.

Stations.	January.	February.	March.	Total.	Total corresponding period '17.
<i>San Fernando and Princes Town District.—(Contd.)</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>
Naparima—Palmiste estate ...	6.61	1.63	.65	8.89	3.91
" Lewisville House ...	6.18	2.09	.97	9.84	2.93
" Hermitage estate ...	6.48	1.35	.48	8.31	2.93
" Petit Morne estate ...	5.81	1.39	.35	7.55	1.51
Princes Town—Craigish estate ...	7.18	3.44	.77	11.39	3.11
" Cedar Hill estate ...	6.71	2.62	.63	9.96	3.48
" Williamsville estate ...	4.35	2.00	.67	7.02	3.89
" Esmeralda estate ...	5.19	2.69	...	...	4.00
" New Grant estate ...	6.26	4.02	3.77	14.05	5.54
" Constabulary Station ...	7.04	2.30	.59	9.93	2.85
" Hindustan estate ...	4.85	3.81	1.59	10.25	4.00
" La Retraite estate ...	8.05	4.71	2.77	15.53	8.44
" Malgretoute estate ...	7.07	2.68	.74	11.09	3.68
" Friendship & Ben Lomond estates ...	6.67	3.22	.86	10.75	3.80
" Los Naranjos estate ...	5.61	2.45	2.87	10.93	3.20
Poole—El Rosario estate ...	9.76	3.97	1.50	15.23	7.58
<i>South-west District.</i>					
Oropuche—Constabulary Station ...	7.44	1.97	.36	9.77	5.16
" Pluck estate ...	5.74	2.34	1.36	9.44	3.27
Siparia—Constabulary Station ...	5.11	3.70	1.13	9.94	5.10
" Alta Gracia estate ...	5.43	3.75	.93	10.11	5.61
Guapo—Adventure estate ...	4.53	2.28	.53	7.34	7.00
Point Fortin—Constabulary Station ...	3.77	3.16	1.60	8.53	8.75
Erin—La Ressource estate ...	4.18	3.00	...	...	8.66
" La Union estate ...	4.24	3.88	1.65	9.77	10.03
" Industry estate ...	4.09	4.30	1.98	10.37	9.48
Cedros—La Retraite estate ...	7.48	4.22	2.53	14.23	11.65
" Beaulieu estate ...	5.74	2.80	3.50	12.04	7.99
" Perseverance estate ...	6.21	3.48	4.72	14.41	8.19
" St. Marie estate ...	5.58	3.78	3.74	13.10	10.29
" Constabulary Station ...	4.76	3.54	4.99	13.29	9.65
" St. Quintin estate ...	7.48	3.21	4.59	15.28	7.17
Iconos—Constance estate ...	18.42	3.60	13.46	35.48	4.82
Irois—Government School ...	2.72	6.32	2.40	11.44	14.57
<i>South Coast.</i>					
Moruga—Constabulary Station ...	5.60	3.64	.72	9.96	5.55
<i>East Coast.</i>					
Matuna—La Juanita estate ...	8.74	5.59	2.39	16.72	8.11
Mauzanilla—Constabulary Station ...	7.37	6.47	1.69	15.53	9.51
" Indrasan estate ...	7.39	5.97	2.14	15.50	...
Sangre Grande—New Lands estate ...	8.58	4.22	1.63	14.43	6.39
" Evansdale estate ...	7.65	4.85	3.10	15.60	9.91
" Grosvenor estate ...	8.93	6.68	2.90	18.51	11.74
" San Hilario estate ...	8.13	2.87	1.48	12.48	8.15
" San Francisco estate ...	8.70	6.36	2.31	17.37	...
Mayaro—Constabulary Station ...	10.89	4.05	1.19	16.13	7.43
<i>North Coast.</i>					
Blanchisseuse—Constabulary Station ...	13.97	5.80	2.25	22.02	13.02
Grande Rivière—Mon Plaisir estate ...	10.21	7.18	1.98	19.37	12.44
Toco—Aragua House ...	10.89	4.81	1.49	17.19	7.05
" Constabulary Station ...	10.23	4.70	1.26	16.19	8.09
Point Galera—Light House ...	8.72	3.74	1.10	13.56	4.60
<i>Tobago.</i>					
Tobago—Hermitage estate ...	7.08	4.13	2.23	13.44	7.53
" King's Bay " ...	7.68	3.81	3.20	14.69	12.09
" Roxburgh " ...	7.73	3.65	4.91	16.29	11.45
" Lure estate ...	7.21	3.36	3.64	14.21	9.66
" Botanic Station ...	4.40	1.59	.83	6.82	6.32
" Government Farm ...	2.47	1.07	1.12	4.66	4.67
" Friendship estate ...	4.87	2.73	.13	7.73	4.67
" Riversdale " ...	5.69	2.70	1.48	9.87	7.61
" Bon Accord ...	4.27	2.02	.24	6.53	..

PACKING AVOCADO SEEDS FOR TRANSPORT.

IN those countries where *Persea gratissima* (the Avocado) is largely grown it is common knowledge that the seeds germinate very quickly, in fact in some cases when the ripe fruit is opened germination has already begun. The difficulty of transporting them a long distance, and so that they may retain their vitality will therefore readily be understood.

In consequence of a request from Egypt for Avocados for cultivation, an experiment was carried out at the St. Clair Experiment Station to find whether it was best to ship fruits or seeds, and what was the most suitable packing material. For this purpose 200 Avocados were divided into four lots of fifty; two fifties being fruit and two fifties only seed. These were packed on October 9, placed in a cool shed and next examined on December 22, *i.e.*, nearly eleven weeks which normally is ample time for a voyage to almost any part of the world.

The following table indicates the packing material and the number of good seeds when the boxes were unpacked:—

	IN CHARCOAL.		IN COCONUT FIBRE.	
	Alive.	Dead.	Alive.	Dead.
Whole fruits ...	5	45	4	46
Seeds ...	48	2	50	0

Examination showed that those seeds packed in coconut fibre had made a great deal of root and the plumule was very much elongated, whereas those packed in charcoal had made much less growth, proving charcoal was the better material to use. Packing the whole fruit was a decided failure judging from the results obtained, only nine seeds out of one hundred being alive, compared with ninety-eight when the seeds alone were used.

R. O. WILLIAMS.

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE, TRINIDAD & TOBAGO.

Issued by the Department and Board of Agriculture.



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- „ *6—The Froghopper Fungus and its Practical Application.
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- „ *8—Results obtained in the Study of the Froghopper during the Wet Season of 1910.
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- „ 10—Special Cotton Seed.
- „ *11—Short Hints on Cacao Cultivation.
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- „ 13—Tobacco Cultivation in Tobago.
- „ 14—Rainfall Returns for 9 months ending September, 1912.
- „ 15— „ „ 3 months „ March, 1913.
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- „ 18—Agricultural Credit Societies Ordinance, Trinidad and Tobago.
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Department of Agriculture.

GOVERNMENT STUD ANIMALS.

THE following are the arrangements for September with regard to Stud animals of the Government Farms in Trinidad and Tobago.

Stallions.

<i>Name.</i>	<i>Class.</i>	<i>Where standing for Service.</i>	<i>Fec.</i>	<i>Groom's Fee.</i>
QUICKMATCH.	Thorough-bred	...Govt. Farm Trinidad...	\$ 10.00	60c.
SIR HORRY...	Thor'gh-bred Hackney..	Govt. Farm ..	5.00	60c.
SIR HORACE..	Half-bred Hackney	Govt. Farm ..	5.00	60c.
RILLINGTON SPARTAN..	Cloveland Bay..	Brechin Castle Est., Couva ..	5.00	60c.
MARAT	...Thorough-bred	...Govt. Farm Tobago ...	4.80	60c.

Jack Donkeys.

Monarch	...American Donkey	...Palniste Estate	... \$ 5.00	60c.
President	... Do. do.	...Govt. Farm, Tobago...	5.00	60c.

Bulls.

A.—AT GOVERNMENT FARMS.

TRINIDAD.		TOBAGO.	
<i>Class.</i>	<i>Fec.</i>	<i>Class.</i>	<i>Fec.</i>
2 pure-bred Zebu	...	1 Half-bred Holstein	...\$1.00
1 " Jersey	...	1 Pure-bred Zebu	... 1.00
2 half-bred Red Poll	... 1.20c.	Ruby—Half-Bred Red Poll...	1.00

B.—AT PUBLIC PASTURES.

<i>Place.</i>	<i>Class.</i>
Queen's Park Savannah	2 Half-bred Shorthorn; 1 Half-bred Guernsey.
Mucurapo Pasture:	1 Pure-bred Shorthorn; 1 Half-bred Holstein.
St. Augustine Estate:	1 Half-bred Holstein; ½ Bred Shorthorn
River Estate:	1 Half-bred Zebu;
San Fernando:	1 Pure-bred Holstein; ½ Bred Jersey.
Arima:	1 Half-bred Jersey.

Pigs.

AT GOVERNMENT FARM, TRINIDAD.

White Yorkshire, Berkshire, TamworthFee \$1.00;
Attendant's Fee 25c.		

AT GOVERNMENT FARM, TOBAGO.

BerkshireFee 50c.
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POULTRY.

GOVERNMENT FARM, TRINIDAD.

Eggs of Barred Plymouth Rocks, Black Minorcas, Brahmas (light), Rhode Island Reds, White Leghorns\$1.00 per doz.
Great Kind Pigeons	... ..	40c. and 60c. per pair.

GOVERNMENT FARM, TOBAGO.

Eggs of Plymouth Rocks, Black Minorcas, Rhode Island Reds 48c. per doz.
Also Cocks and Pullets of Plymouth Rocks and Rhode Island Reds.

Department of Agriculture.

NURSERY STOCK.

A few thousand plants of *Coffea robusta* and Limes in pots are available at the St. Clair Experiment Station. Orders for Mangos, Oranges, Grape Fruit, and Limes from beds should be sent in without delay for supply in a few months' time. Orders should be addressed to the Acting Superintendent, St. Clair Experiment Station, or to the Officer in Charge Botanic Station, Tobago.

Special quotations at St. Clair for Cacao, Coffee and Limes grown from selected seeds are as follows :—

Plants purchased in lots of 1 to 1,000 plants	} Delivered at Nurseries uncrated.
8 cents per plant.	
Plants purchased in lots of several thousands	
2½ cents per plant.	

Plants purchased in lots up to 100 at 4 cents	} Delivered at Railway Station, Port-of- Spain or Queen's Wharf, securely packed in open crates.
per plant.	
Plants purchased in lots up to 1,000 at \$3.50 per 100.	
Plants purchased in lots of several thousands at \$33.00 per 1,000.	

Tobago prices on application at the Botanic Station, Scarborough.

Budded Avocados select varieties at 12 cents, Budded Oranges at 24 cents and Grafted Mangos at 24 cents should also be booked at once.

Budded Cacao 12 cents each or in lots of over 100 at 8 cents.

Lime from beds 1½ cents per plant for lots over 100.

A select stock is also kept of other fruit, ornamental and flowering trees, palms, etc., a list of which can be obtained on application. Large orders must be booked six months previous to the date when the plants are required as large supplies are not kept on hand for casual demands.

NURSERY STOCK LIST.

The new edition of this list giving prices of plants usually stocked at St. Clair Experiment Station can be had on application.

THE BULLETIN.

The Bulletin is issued quarterly, price sixpence per number, or two shillings per annum post free in the Colony. To other subscribers postage extra. On sale at Messrs. Muir Marshall, and Davidson & Todd.

Subscriptions can be remitted by Postal Order, to the Acting Director of Agriculture, St. Clair Experiment Station. If so addressed they will come post free from within the Colony.

Part 1, 1918.—Report on St. Lucia Lime Factory. Storage of Black-eye Peas (Illustrated); Fruits of Trinidad and Tobago; Uses and culture of Dasheens (Illustrated, Prize Competition Reports. &c., &c.

Part 2, 1918.—Coffee excelsa, Yam cultivation, Insects affecting Vegetables, Rubber Tapping Experiments, Tobago Orchids, &c., &c.

OUR LOCAL FOODS, Their Production and Use.

BY

W. G. FREEMAN, B.Sc., &c., and R. O. WILLIAMS.

Price 3d.

This pamphlet gives directions for the cultivation of the chief local food crops and treatment of pests; also recipes for the use of corn meal, sweet potatoes, dasheens, tannias, yams, cassava products, &c.; the preparation of meals and their use as flour substitutes; preparation of coconut butter, &c.

To be obtained from the Department or from Messrs. Muir, Marshall, or Davidson & Todd.

Board of Agriculture.

PEST GANG.

The Board of Agriculture has in its employ a man who is trained in spraying, cutting out canker and cacao beetles, and other sanitary work. This man is available to teach such work to estate labourers. The wages of the man, while actually employed by the estate, are to be paid by the estate, but travelling expenses will be paid by the Board. Materials used in spraying will be supplied at cost price, and where possible, spray pumps will be lent.

From September to November is the time for spraying cacao trees for the prevention of thrips and black rot; and early in the dry season for the Algal disease and die back.

The Board of Agriculture has on hand a supply of bluestone, which is sold to planters at cost price plus 10 per cent., also nicotine sulphate, the best insecticide for thrips, which is sold at \$10 per gallon.

Further information in regard to Pest Gang, cost of spraying, etc., and applications for bluestone and nicotine sulphate should be made to

THE HONORARY SECRETARY,

Board of Agriculture, Port-of-Spain.

BULLETIN
OF THE
DEPARTMENT OF AGRICULTURE
Trinidad and Tobago.

PART 2.]

1918.

[VOL. XVII.]

Increased Production and Use of Ground Provisions in Tobago—Attention has been directed before to the gratifying response in Tobago to the call for the greater production of ground provisions. For the year ending March 31, 1914 Tobago exported to Trinidad ground provisions to the value of £3,126 and in the following year £4,548. In nine months of 1915 (April to December) the value rose to £8,380, and in January to December, 1916 to £10,274, an increase of about £7,000 on the pre-war figures.

Combined however with the advice to grow more, the Department has always added that to use more and so reduce the consumption of wheaten flour. In 1917 the exports from Tobago fell to £3,574. Whilst in Tobago early this year I was informed that the cause of the drop in exports was due to the much greater use of ground provisions by the people themselves. Mr. H. P. Strange, the Commissioner-Warden, has recently been able to confirm this as shown by the following note: "The falling off in exports of ground provisions to Trinidad last year was due as we thought to a shrinkage in imports of breadstuffs. Scarborough depôt alone, out of twelve depôts served by the steamer, took 17 tons less flour than in 1916. This alone represents some 60 or 70 tons of ground provisions."

From all reports provision planting is being very actively proceeded with this year, and it is hoped that the result will be as expressed a few months ago at public meetings in Tobago, namely that they will grow enough to eat as much as they did last year and also to send to Trinidad at least as much as they did in 1916.

Storage Bins for Peas and Corn.—The two new storage bins for corn, peas, &c., have been completed and the Department is ready to accept black eye peas for kiln drying and storage at terms which have already been given in this Bulletin (p. 17) and in the press, namely 10 cents per bag per month, minimum charge 20 cents; and allowance of ten per cent. of the weight to cover loss in drying. Corn will also be accepted for drying and storage on similar terms, the allowance for the loss of weight depending on the condition of the corn as delivered. The Department also has a corn mill and will dry and mill corn for private persons at one cent per lb. Full particulars as to charges, &c., can be obtained on application to the Manager, St. Augustine Estate, St. Joseph.

Growth of the Lime Industry in Trinidad.—In the very useful pamphlet *Lime Cultivation in the West Indies* published by the Imperial Department of Agriculture in 1918 a table is given of the value of lime products exported from the various colonies in 1911. In the following

table these figures are given together with those for more recent years:—

			1911.	1914-15.	1916-17.
			£	£	£
Dominica	...	...	73,882	187,031	172,352
Montserrat	...	...	9,127	15,133	18,276
Grenada	...	...	Not given.	1,375	14,486
Trinidad	...	...	1,628	2,655	8,698
St. Lucia	...	...	290	6,449	6,360

Dominica has more than maintained her position as the premier lime producing island. Grenada has made a very rapid advance, and Trinidad, especially during the last few years, has also materially increased her output. The figures afford a good idea of the relative importance of lime cultivation in the various islands.

Cotton Cultivation.—Cotton is one of the products which has increased greatly in price during the war. The last consignment of Sea Island cotton grown at St. Augustine Estate realised 3s. 4d. per lb. in England. A limited amount of seed is available for distribution to any persons who may desire it, and directions for cotton cultivation will be furnished on application. The Department has at St. Augustine two power gins and a baling press, and seed cotton can be ginned and baled for export at a charge of two cents per pound. The Department will also pay \$50.00 per ton for the seed which is used at the Government Farm as a stock food. If cultivators prefer, cotton will be ginned and baled free in exchange for the cotton seed.

Fruit Cultivation.—The Special Fruit Committee of the Agricultural Society has presented its report (*Proc. Agr. Soc.* XVIII, 1918, 739-52) which was adopted at the meeting of the Society on July 11. The report summarises the principal varieties of fruit already in the colony to which attention should be given for both export and local trade and suggests others which might be introduced. It gives the results of enquiries made in the West Indies, Bermuda, Canada, and the United States as to the possibilities of developing an export trade, which indicate that the immediately available markets are Barbados, Bermuda, and to a less degree Antigua and St. Kitts. Of special interest are the satisfactory results of trial shipments by Mr. A. V. Stollmeyer of oranges and grape fruit to Bermuda. The Committee recommends the formation of a Trinidad and Tobago Fruit Growers Association to be worked on a co-operative basis, on somewhat similar lines to the Antigua Onion Growers Association. The question has been referred back to the Committee to draw up a working scheme for such an Association.

Lime Factory for Tobago.—As already announced the Government proposes to erect a co-operative lime factory in Tobago. Mr. Meaden's visit to St. Lucia was undertaken for the purpose of studying the method of working the one in that island, which was the first Government Co-operative Lime Factory in the West Indies. The report on it appeared in the last issue of this Bulletin (pp. 4-13). More detailed estimates of the cost have since been prepared and submitted to His Excellency the Governor, who has decided that, owing to the impossibility of getting the necessary machinery now, at a reasonable cost even if at all, the erection of the factory must stand over until after the war. Meanwhile the necessary plans are being prepared by the Public Works Department.

It is estimated that there are now about 150 acres of limes on estates in Tobago ranging from one to eight years. There is a large demand for plants from the Botanic Station, and everything thus points to there being a sufficient supply of limes to warrant the factory being started at as early a date as war conditions permit.

Effect of Grass on Palms.—In about June 1914 I put out in my garden *Areca Catechu* palms, some on a grass lawn, and the others in beds newly made at that time on the same lawn. Hibiscus, &c., were grown in the beds, which were never highly manured, whilst the adjacent palms in the grass merely had small circular areas around them kept clean. It was soon apparent that the vigour and rate of growth of the plants under these different conditions were very unequal. The plants in the grass remained stunted, with short yellowish leaves. Those in the beds grew rapidly in height, produced stems early and had healthy, large, dark green foliage. So uneven were they that I cut them all down in October 1917. Their average measurements were then as follow :—

		<i>In Grass.</i>	<i>In Cultivated Ground.</i>
		Average of 5 trees.	Average of 11 trees.
Total height ...	...	5 ft. 9 in.	14 ft. 3 in.
Stem to base of leaf-sheath		1 „ 1 „	4 „ 9 „
Length of leaf-sheath ...	...	1 „ 4 „	2 „ 5 „
Girth ...	...	7 $\frac{3}{4}$ „	14 $\frac{1}{2}$ „
Number of leaf scars ...	...	11·2	11·4

It is important to note that both sets had produced the same number of leaves as shown by the number of leaf scars on the stem, but whereas the average height of the palms in the grass was 5 ft. 9 in. that of the plants in the beds was 14 ft. 3 in. and their other dimensions including girth were proportionate.

The stunting effect of grass on fruit trees has been amply demonstrated in England, the United States, &c. Whether it is due to any toxic excretion by the grass roots is still under investigation. It may be due to the competition between the very numerous roots of the grass and those of the trees, for the water and food materials present in the soil. Coconuts in grass-covered land often grow slowly and look unhealthy and yellow. Planters having areas under such conditions should clean a part and plant with some cover or catch crop and ascertain whether grass is not playing the same retarding effect on their coconuts as in this case on *Areca* palms. The early years are important to all palms as failing proper treatment then they may never form strong, well developed plants.

Ground Provisions Dépôt.—The Government Dépôt in Port-of-Spain for the purchase and sale of ground provisions is making satisfactory progress under the management of Mr. L. S. Redman. The sales during recent months have increased steadily.

In order to meet the convenience of purchasers who find a difficulty in getting produce from the dépôt, a horse and van has been added and deliveries are now made daily in Port-of-Spain and suburbs.

The dépôt was founded to provide a ready market for those who are growing foodstuffs and also to serve as a source of supply to the large population of the capital of the Colony who naturally are unable to produce much for themselves. The system of payment through the collectors of railway stations or steamer dépôt keepers secures the prompt receipt of their dues by those who send produce.

Yams as a paying Crop.—In the last issue of this *Bulletin* (p. 1) examples were given of the profitable cultivation of ground provisions in Trinidad. Attention is directed to the report, pages 66–8, on cultivation of yams at St. Augustine Experiment Station showing, with various planting distances, an average profit of \$718 per acre.

At St. Augustine, yams were also grown this year as an estate crop and the following results obtained by Mr. McInroy, the manager. From 3,666 holes 20,346 lb. of yams were obtained and sold at an average price of 2½ cents per lb. The total expenditure was \$178.00, cost of cultivation \$150 and \$28 the value of the yams used for planting; the receipts were \$508, leaving a profit of \$430. The area cultivated was approximately three-quarters of an acre, making the profit equivalent to \$578.00 or approximately £120 per acre.

Berseem or Egyptian Clover.—The Department of Agriculture has received a small supply of seed of Berseem or Egyptian Clover, the most valuable Egyptian forage plant. It was sent by the Ministry of Agriculture owing to interest taken in it by Mr. A. A. Cipriani whilst stationed in Egypt. There is no guarantee that it will thrive here. Mr. H. A. Ballou, the Entomologist of the Imperial Department of Agriculture who has been engaged on special work in Egypt, in writing to me says:—"I have just had a letter from Mr. A. A. Cipriani, who is here with the British West Indian Regiment, asking whether the

Egyptian Clover, Berseem, would do well in Trinidad. I have replied that I should not expect it to be very successful and why, but at the same time I am asking the Director, Horticultural Section, Ministry of Agriculture, to send out seed, some to you and some to the Imperial Commissioner for trial. Berseem in Egypt is a winter crop, grown under the influence of temperatures much lower than anything in the West Indies. Night temperatures of 35 deg. F. and maximum day temperatures of 60-65 deg. F. are frequent occurrence here during the weeks when this crop is making its best growth. The soil is cool and there is much more water available than would be the case in the winter months in the West Indies. Perhaps it may do well in the cooler parts of Trinidad." The Department of Agriculture is making experiments at St. Clair Experiment Station, St. Augustine Experiment Station and in Tobago, and will be glad to send a small packet of seed for trial, free to any cultivator in the Colony (so long as the supply lasts) and to receive later reports as to its growth.

The following notes on Berseem are taken from Bailey's *Encyclopædia of Agriculture*. "An annual, clover-like forage plant now being grown experimentally in the United States, especially in the irrigated Southwest. Its particular recommendations are rapid growth, adaptability to alkali lands and usefulness in reclaiming them, high rank as a nitrogen-gatherer, unusual food value and conditioning properties, exceptional succulence, palatability and heavy yield. Berseem is the basis of Egyptian agriculture, both by reason of its instrumentality in the reclamation of alkali land and of its almost universal use as forage. The plant is two to five feet tall, according to variety, heads whitish, intermediate in size and shape between common red and white clovers. "There is not yet experience enough with Berseem in the United States to warrant definite cultural directions. Naturally wet land, even that on which water stands a part of the time, is best. The seed is broadcasted at fifteen to twenty pounds per acre and harrowed in lightly, as for alfalfa or clover. One cutting is secured in April and one May, after which the plant succumbs to increasing heat. Frequent irrigation is required. Harvesting is the same as for alfalfa or clover." Application for seed should be addressed to the Acting Superintendent, St. Clair Experiment Station.

The above note has already appeared in the local press, but so far only two requests for seed from Trinidad agriculturists have been received.

W. G. FREEMAN.

COFFEE.

COFFEA EXCELSA.

At the St. Clair Experiment Station, Port-of-Spain is a small plot of *Coffea excelsa* grown from seed introduced in 1905 or 1906, the following note being published in the *Bulletin of the Botanical Department, Trinidad*, VII 1906-07 p. 18:

"Under this name a small quantity of coffee seed has been kindly sent to the Department by an eminent Paris Seed Firm. It has been found in the Territory of the Chari (in the French Colony of the Congo). The seed in appearance is very similar to that which has already been grown here under the name of *Coffea robusta* which is also reported from the Congo. The seed has germinated well and it is hoped that it may be successfully raised."

Previous to 1911 the shade trees were removed both from this plot and from an adjoining one of *Coffea robusta*. From 1912 shade was restored by planting Nicaragua cacao shade (*Gliricidia maculata*) and Wild tamarind (*Leucaena glauca*) through these two plots. Very dry years followed and the *Coffea robusta* suffered very considerably. The *Coffea excelsa* on the other hand kept in good condition and is apparently a plant which has considerable powers of thriving under very adverse conditions. During 1916 and 1917 it has fruited very heavily. From 28 trees 205 lb. of cherries were gathered in 1917 or nearly 9 lb. per tree. Planters who have seen the plot have ordered considerable numbers of plants for trial.

In 1916 no plants or seeds of this coffee were sold. In 1917, 74 lb. of seed and 718 plants. In 1918, 1 lb. of seed, 1,991 plants have been sold and 9,000 are in stock all of which are already booked.

INFORMATION FROM DR. CRAMER.

Dr. P. J. S. Cramer of Surinam and Java, the well known coffee expert, writing to Mr. J. B. Rorer of the Board of Agriculture on July 30, 1918 and October 4, 1915 gave the following information:

"Here (Java) I found several new coffee species, I imported as young plants, grown into bearing trees. Some look rather promising especially *Coffea excelsa* of which species I saw a small plot in the St. Clair Garden, I think. It is a species closely allied to *Coffea liberica*, but a stronger grower, and apparently a better producer; the seeds are however smaller than that of the true Liberian coffee."

"This species belonging to the group of *C. liberica* requires a planting distance of at least 12 feet by 12 feet. It prefers low situations but may be planted up to 2,000 feet above sea level. Large leaved trees of vigorous growth. Seeds smaller than *C. liberica* but of good quality."

COMPARATIVE YIELD OF DIFFERENT COFFEES.

The *Bulletin Agricole du Congo Belge* VII, 1916. 297 gives the following information as to the weight of cherries of various coffees required to give one kilo of marketable coffee:

<i>Coffea canephora</i> var. <i>sankuruensis</i>	...	...	4.7 kg.
<i>C. robusta</i> , Kali Sepan jang	...	...	4.2
<i>C. canephora</i> var. <i>kwiluensis</i>	...	...	3.8
Cafe Kwilu ...	...	...	3.6
<i>Coffea canephora</i>	...	...	3.8
<i>C. robusta</i> (Java)	...	...	3.8
Cafe de l'Uganda	..	...	3.6
<i>Coffea excelsa</i>	...	...	5.5
<i>C. liberica</i>	...	...	12.0
<i>C. Dewevrei</i>	...	...	8.8
<i>C. aruwimiensis</i>	...	...	6.7
<i>C. arabica</i>	...	...	5.1

At St. Clair in 1917 50 lb. of cherries gave 8½ lb. of coffee, *i.e.*, in the proportion of 5.9 kilos of cherries to one of coffee, as compared with 5.5 kilos for *C. excelsa* in the above table.

NOTES BY THE DISCOVERER OF COFFEA EXCELSA.

In the *Monthly Bulletin of Agricultural Intelligence and Plant Diseases*, October 1914 appeared the following interesting notes on a paper by M. Aug. Chevalier who originally brought this coffee into notice.

"The writer discovered this species of coffee in Central Africa and distributed seeds to several experiment stations, including those in Tonking, Java, French Guinea and the Belgian Congo.

"NATIVE CLIMATE.—*C. excelsa* is found in the wild state at altitudes of 2,200 feet in a climate which is dry for six months of the year and has a rainfall of at least 40 inches during the remaining six months. The summer temperature is tropical whilst in December and January it falls below 10° C. at night.⁽¹⁾ This type of climate occurs in a number of countries. It has been shown that this species succeeds well in equatorial regions, so that its cultivation is possible over wide areas.

"QUALITY.—The coffee obtained from Central Africa showed a satisfactory strength in caffeine, and though somewhat bitter it had an excellent flavour.

"INTRODUCTION IN TONKING AND JAVA.—In Tonking its growth has been remarkable and entirely free from insect and fungoid pests. The bean is small and uniform in size and it is hoped to sell it in competition with Arabian coffee blended with Mocha. Numerous specimens have been planted in Java in the experiment station at Bangilan near Malang and in the Tjikeumeuth Garden near Buitenzorg. Field cultivation has also been begun in the Dutch East Indies.

(1) 10° C = 50° F. (Ed.)

"SELECTION.—This species is being improved by Dr. P. J. S. Cramer. It shows variation in almost all its botanical characters. In appearance it is less luxuriant than *C. liberica* though it is hardier and earlier.

"CULTIVATION.—This species is particularly robust in Java. It commences to flower in the second year and yields a crop of berries in the third year. The trees should be planted at least 12 feet apart each way. Each tree is planted in the centre of a square plot cultivated and made to slope in the opposite direction to the general slope of the land and forming a hollow at the lower end so as to prevent erosion of the surface soil. Young plants of "lamtoro" (*Leucaena glauca*) are planted on the border of each square and periodically pruned so as to prevent the growth of old shoots. Stumps of *Leucaena* 16 inches high are planted at the four corners of the square at the same time as the coffee plants. They are allowed to grow freely until the fifth year, when they are cut down; as the coffee plants now cover the ground, the *Leucaena* along the borders of the squares and some of those at the angles are removed so as not to shade the coffee too much.

"YIELDS.—At Bangilan an annual yield of 616 lb. per acre or about 8 lb. per tree has been obtained. M. Cramer mentions the plantation at Kedatong (South Sumatra) where 54 plants of *C. excelsa* of four to five years growth yielded 7lb. per tree.

"MARKET VALUE.—The value of the coffee approaches that of Liberian coffee and according to M. Boom it amounts to about £20 per acre. The beans require particular care since they are enclosed within a thin skin which must be completely removed before the highest prices can be obtained. Unfortunately only a small supply of the best strains exists and it is only at Bangilan that a uniform collection has been seen by the writer.

IMPERIAL INSTITUTE REPORT ON TRINIDAD SAMPLE.

"The sample of coffee which is the subject of this report was forwarded to the Imperial Institute by the acting Director of Agriculture in Trinidad and is referred to in his letter dated December 12, 1917. The sample was stated to be derived from *Coffea excelsa*.

"DESCRIPTION OF SAMPLE.—The sample weighed 8½ lb. and consisted of beans freed from the parchment and skin. The beans were of a greyish-yellow colour and varied considerably in size. The general shape of the beans was oval with one flat side, but many were rounded. The sample was in good condition, but contained a few damaged beans.

RESULTS OF EXAMINATION.—The coffee was examined at the Imperial Institute with the following results:

					per cent..
-	Moisture	...	...	...	8.5
	Caffeine	...	...	...	1.20
	Total Nitrogen	...	...	...	2.18
-	Ash	...	...	...	3.2
-	Average weight of a single bean 0.16 gram.				
-	Number of beans required to fill a 50 c.c. cylinder—204.				

The results of the chemical examination show that the coffee is of normal composition.

"COMMERCIAL VALUATION.—Samples of the coffee was submitted for valuation to two firms of brokers, who reported as follows :

(1.) The first firm regarded the coffee as of Robusta variety mixed with Arabica sorts. They described it as dull and dingy, but expressed the opinion that with greater care in preparation the appearance and quality could be much improved. The firm valued the coffee at 80s. per cwt. in London, adding that the prices of Robusta coffee generally fluctuate with those of coffees from Brazil.

(2.) The second firm also considered the sample to represent a Robusta coffee, of hard bean and fair size. They regarded the appearance of the raw beans as attractive but distinctly dull. The coffee gave a very dull "roast" and the liquor closely resembled that of Liberian coffee which would make it unattractive for the British trade. In spite however of these drawbacks the firm estimated the value at about 75s. per cwt. in London at the present time, adding that in normal times there would be a good market for such coffee for the export trade from the United Kingdom. The present prices for this class of coffee are from 10s. to 15s. per cwt. above the pre-war values.

"For comparison with the above valuations the following quotations for Robusta and Liberian coffee in London market on the same date may be given:—

			per cent.
Robusta coffee—Plantation	...	...	70s.-80s.
Liberian coffee, East Indian	...	...	75s.-85s.
do. African fair	...	...	60s.-65s.
do. Malay	...	...	80s.-85s.
do. Java and Sumatra	...	...	75s.-90s.
Brazilian Santos, Superior	...	...	74s.-75s.
do. Prime	...	...	75s.-76s.
do. Extra	...	...	77s.-78s.

"REMARKS.—There is little doubt that coffee from *Coffea excelsa* as represented by this sample would be readily saleable in the London market under normal conditions at prices similar to those ruling for Liberian and Robusta coffees. The acting Director of Agriculture in forwarding the sample stated that *Coffea excelsa* thrived better than other varieties under certain conditions of climate and soil, and its cultivation in Trinidad may therefore deserve consideration."

FOOD CROPS.

EXPERIMENTS ON YAM CULTIVATION 1917-18.

By JOSEPH DE VERTHUIL, F.I.C., F.C.S.

Superintendent of Field Experiments.

AND L. A. BRUNTON,

Assistant Superintendent of Field Experiments.

The following report of experiments on yams made at St. Augustine Experiment Station during the season of 1917-18 may be useful to those interested in the cultivation of this crop.

Trenches and holes were dug two feet wide by eighteen inches deep, unless otherwise specified. The weight of the "plants" for all the experiments was approximately a quarter of a pound. The plants were put into the ground at the end of May and beginning of June, 1917, and reaped between February 18 and 28, 1918, *i.e.*, about nine months later.

VARIETIES.

Three varieties, the Barbados Lisbon, Horn and Red yams were tried in eight separate plots in trenches three feet apart and the tubers planted two feet apart. The following yields were obtained:—

Variety.	Area planted.	PER ACRE.	
		Yield.	Value of crop at 3 cents per lb.
	Sq. ft.	Tons.	\$ c.
Lisbon ...	1,178	18.47	1,241 18
Horn ...	1,178	14.66	985 15
Red ...	1,178	11.95	803 04

The Lisbon is the most prolific yielder, having given 3.81 and 6.52 tons more of yams per acre than the Horn and Red yam respectively.

SELECTION OF PLANTS.

An experiment was made with the object of ascertaining whether it was preferable to use the tops, centre or bottom portions of the tubers for planting purposes.

Trenches were prepared three feet apart and the plants put in at a distance of two feet. The plots were arranged so as to have six duplications.

Description.			Area planted.	Yield per acre.
			Sq. ft.	Tons.
Top ...	...	...	648	13.92
Centre ...	...	...	648	14.34
Bottom ...	...	...	648	13.86

From the above it will be seen that the difference is very small and within the limits of experimental error; there is apparently no advantage in selecting any special part of the tubers for planting.

METHODS OF PLANTING.

As regards the method of planting, two questions arise :—

- (1.) Is it more profitable to plant in holes or trenches ?
- (2.) What is the best planting distance ?

In this experiment trenches were dug two feet wide by eighteen inches deep, four feet apart and planted at distances of eighteen inches, two and four feet apart respectively. Holes were dug two feet wide by eighteen inches deep at distances of four feet by four feet and four feet by three feet respectively. Another set of holes were dug two feet wide but only eight inches deep, trash and manure were applied to one-half of these holes as is usually done, whereas no trash or manure was put in the others which were simply refilled with loose earth from around and the soil drawn up in a hill over the holes.

Barbados Lisbon yams were planted throughout these plots.

The results obtained are given below :—

Plot.	Area planted.	Treatment.	PER ACRE.		
			Yield.	Cost of cultivation and plants.	Net profit.
	Sq. ft.		Tons.	\$ c.	\$ c.
1	672	Holes 8 inches deep 4' x 3' without trash and manure	11.12	138.80	608.46
2	672	Holes 8 inches deep 4' x 3' with trash and manure	11.04	134.83	587.19
3	2530	Holes 18 inches deep 4' x 3'	14.60	198.63	782.49
4	1584	Holes 18 inches deep 4' x 4'	8.50	174.27	396.93
5	1660	Trenches planted 18 inches apart	15.06	266.12	745.90
6	1640	Trenches planted 2 feet apart	14.22	232.50	703.06
7	1640	Trenches planted 4 feet apart	11.98	232.09	572.96

The soil at St. Augustine being a fairly loose sandy loam, the suggestion was made that there might be no necessity for digging such deep holes as is usually recommended in yam cultivation. The results obtained from plots 1, 2 and 3 show that notwithstanding the higher cost of preparation it is more advantageous to have deep holes, *i.e.* eighteen inches deep. If we compare plots 3 and 4 and plots 5, 6 and 7 it will be seen that a larger profit is obtained per acre from close than from wide planting; three feet by two feet, or four feet by eighteen inches, *i.e.* six square feet per plant has given the best results. It should be mentioned, however, that the greater distances give a larger return per hole and the largest yams; This is not an advantage as the very large tubers do not sell as readily as the smaller ones.

Trenching is more expensive than holing but as it permits of closer planting it is likely to be more profitable. Moreover the land is better prepared for subsequent crops, especially if the untrenched portion of the first year is worked up for the second year. Holes four feet by three

feet gave 14.60 tons and \$782.49 net profit per acre. Trenches four feet apart, planted at distances of eighteen inches and two feet gave 15.06 and 14.22 tons with a profit of \$745.90 and \$703.06 per acre respectively. With trenches 3 feet apart and planted at a distance of two feet a yield of 18.47 tons was obtained giving a profit of \$975.06 per acre.

LOSS IN WEIGHT ON STORING.

As yams may have to be stored for a long time it is interesting to ascertain what would be the loss on storing. Accordingly 100 lb. of freshly dug yams were weighed on February 13 and re-weighed at intervals of three or four days. On April 26, about 10 weeks later they had lost 10 per cent. in weight but as the market price meanwhile increased about 35 per cent., there was no pecuniary loss on storing. During the last two weeks of the above period the loss in weight was very slight.

AVERAGE RETURNS PER ACRE.

The total area under Yam cultivation at St. Augustine Experiment Station during 1917 was 14,462 square feet or practically one-third of an acre, from which 10,090 lb. of yam were reaped, *i.e.*, 13½ tons per acre.

The value of the crop at three cents per pound works out at \$911.73 and the total cost of cultivation including the purchase of plants was \$197.85 per acre leaving a profit of \$713.88 per acre.

YAMS AT ST. CLAIR EXPERIMENT STATION.

MUCH attention is being given this year in the Experiment Station, St. Clair, to the growing of ground provisions.

A fair quantity of corn has been planted which will be used for seed selection purposes and for feeding the animals employed on the place. As explained previously, *Bulletin XVI*, 1917, 178, oats are now dispensed with completely, ground corn on the cob being substituted. It is therefore hoped that in this matter the Experiment Station will to a large extent be self-supporting this year.

The principal crop of ground provisions however is yams. 5,379 plants have been put in of such varieties as the Red yam, Lisbon, Horn yam and Oush-Oush: A portion of the area planted is being used as a planting distance experiment; 10 trenches each 200 feet long are being used for this purpose, two planted with Red yams at one foot apart, two at 15 inches, two at 18 inches, two at 21 inches, and two at 2 feet. The trenches in each case are four feet apart. It is hoped that this will give us some useful information when the crop is reaped.

A small set of yams obtained from the Department of Agriculture in Barbados are under trial this year, and up to now are growing well. Eight varieties were received under the following names, Blanche Femelle, Femelle, Lisbon, Crop, White yam, Antigua, Seal Top and Oriental. These will be propagated for distribution purposes. In the report of the Barbados Agricultural Department for 1916-17, Mr. J. R. Bovell, I.S.O., F.L.S., gives the results of experiments with yams for the last six years. These are summarized below as of interest to us here. It will be seen that Lisbon and Red yam, two varieties which are generally recognized as giving the best results in this Colony have also done best in Barbados.

Variety.				Yield per acre 1916-17.	Average yield per acre.
				Lb.	Lb.
Blanche Femelle	...	...	...	13,348	9,602 for six years.
Femelle	...	...	...	16,615	9,037 " "
Bottle Neck Lisbon	...	...	...	11,520	5,848 " "
Grenada	...	...	...	7,311	4,741 " "
Blanche Male	...	...	...	1,200	2,798 " "
Lisbon	...	...	...	15,508	14,677 for two "
Red Yam	...	...	...	27,028	12,826 for three "
Crop Yam	...	...	...	6,284	6,207 for five "
White Yam	...	...	..	3,545	4,293 for two "
Antigua	...	...	...	6,259	3,765 for five "

In addition to trench cultivation, yams are also being grown on ordinary "hills." Corn, tannias, red beans, &c., are cultivated between the trenches and hills.

R. O. WILLIAMS.

HINTS TO RICE GROWERS.

The following notes on rice cultivation by Mr. C. M. Roach, Agricultural Adviser of the Board of Agriculture were translated into Hindi and issued to competitors in the Rice Competition last year. They have recently been distributed in both English and Hindi to people taking up for the first time rice cultivation at Erin.

SEED SELECTION.—Do not take seed for planting at random. Choose seed for some quality or other, preferably heavy yielding power. The best paddy has a thin husk, and seed should be taken from large stools with strong stalks and lusty ears that have few or no false grains. Choose all the seed of the same variety at the same time and of the same ripeness. Put the ears whole as they are to dry. When thoroughly dry bind into small sheaves and hang in a cool airy place till sowing time.

TILLAGE.—Always endeavour to keep the soil spongy and sweet to a depth of six inches. If necessary to this end fork or hoe-plough towards the end of every dry season turning in all rotted grass, etc. The finer the soil is kept the better the rice yields.

MANURE.—Always try to keep up the richness of your soil by (1) Returning such stuff as the rice straw and chaff to the field (2) adding material such as the dung and urine of cattle, etc. Plant peas during the dry season: this adds nitrogen. A very little lime sprinkled over the forked soil will keep it sweet.

WATER AND AIR CONTROL.—Have the bottoms of your ponds as level as possible. Make small ones if the land is too sloping. See that the embankments are solid and water-tight and the water intakes and outlets well cut. And be sure that the main outlet to every pond connects directly with a drain of not less than six inches depth running right across. If you have a good regular water supply open your drain frequently to let air in to force the plants and purify the soil; this may be done for two days every two weeks. If the water supply is poor, open only when rain is falling.

PLANTING.—The seed beds should be on high land and well manured. Three strong three-weeks-old seedlings nine inches apart should be the standard for transplanting. Always prime the roots to make the plants taller. Plant in straight rows in the direction of the water current.

CARE OF FIELD.—Weed (by hand) immediately it is necessary. Keep embankments free of foreign growth. Watch for birds, insects, etc. that may do damage and report to the Adviser. If "dhan" shows tendency to fall, plant stakes and run supporting rods or lianes around the falling patches. Do not let grain over-ripe.

GENERAL.—Always consult the Agricultural Adviser of the district whenever in doubt about anything or when anything goes wrong.

UPLAND OR MOUNTAIN RICE.

There are two kinds, one red and the other white after removing the straw.

It thrives well upon hilly and undulating lands, virgin soil (especially loams) give the best results.

The best time to plant is at the beginning of the rainy season, but not before the earth is cool and fairly well saturated. Say about the middle or end of June, or even early in July.

The land to be planted must be thoroughly cleared and clean weeded.

Planting is done by drilling small holes $\frac{1}{2}$ inch deep with a pointed stick, and dropping about 4 seeds in each. The holes should be from 12 to 18 inches apart according to soil. While one person drills the holes two others follow behind dropping seeds.

The field should be cleaned as soon as the plantlets are about a foot high, and the weeds are getting strong.

At the time of cleaning, or immediately after, all empty spaces must be filled by removing a few shoots from the largest clumps or by putting in plants from a nursery.

Rice will be ready for reaping about four months after planting.

Hill rice will yield between 8 and 12 barrels of paddy per acre, or about half the yield of Swamp rice.

This rice is subject to two common diseases. (1.) The withering or burning down when planted too early or too late. (2.) The rotting of the centre bud caused by planting too close.

LIMES.

CITRIC ACID CONTENTS OF TRINIDAD LIMES.

LIMES are principally cultivated as a source of citric acid, in supplying the world's demand for which they compete with lemons grown in Sicily. An interesting account of the Sicilian and the West Indian industries, by Mr. W. R. Dunlop of the Imperial Department of Agriculture for the West Indies, appeared in this *Bulletin* XV, 1916, 7-14. In it he described how concentrated lime juice is sold on the basis of its citric acid contents. "The juice is quoted on the basis of a standard 'pipe' of 108 gallons, containing 64 oz. of acid per gallon."

From tests made in other West Indian Colonies the citric acid in fresh lime juice *i.e.*, the juice of ripe limes, is given as being usually between 12·5 and 14 oz. per gallon, although extreme variations of from 10 oz. to 16 oz. may be met with.

In order to ascertain the acid contents of Trinidad limes analyses have been made at the Government Laboratory of various varieties of limes from a few localities, also of lemons and more recently of an acid seedling pomelo brought to notice by Mr. D. Macgillivray, of Tobago. The last analysis was made by Mr. H. S. Shrewsbury F.I.C., acting Government Analyst, all the others by Mr. A. E. Collens, F.I.C., before he left to act as Superintendent of Agriculture and Government Chemist for the Leeward Islands.

The results are as follow :—

		<i>Percentage of Juice in the Fruit.</i>	<i>Citric acid Ounces per gallon of Juice.</i>	
ORDINARY LIMES				
Green but full	Manzanilla	41·86	...	10·92
Yellow and ripe	St. Clair			
	Exp. Station	55·0	...	12·32
„ „	Cedros	52·0	...	13·21
SEEDLESS LIMES				
Three-quarter ripe	Manzanilla	49·02	...	11·30
Yellow and ripe	St. Clair	53·50	...	11·58
SPINELESS LIMES				
Yellow and ripe	St. Clair	56·50	...	13·66
LEMONS				
Yellow and ripe	Cedros	37·77	...	10·75
POMELO (Acid kind)				
Ripe	Franklyn's, Tobago	33·8	...	5·65

Five fruits of the pomelo were analysed separately. The figures given above are the average results. The percentage of juice ranged from 31·9 to 40·8, and the citric acid contents from 5·06 to 6·16 ounces per gallon of juice.

It will be noticed that the seedless lime is the poorest in citric acid. This variety is also the most difficult to propagate as budding has to be resorted to in the absence of seeds. This character however gives it a certain advantage for growing near the house for the preparation of lime drinks, and for other table uses.

The Spineless lime gave the best results as regards citric acid contents, but before growing it on a large scale care should be taken to ascertain whether it is as hardy and bears as well in the particular locality as the ordinary lime. Considerable attention has been given to the spineless lime in Dominica, where it first came into notice in 1891. The Imperial Department of Agriculture pamphlet *Lime Cultivation in the West Indies* records that its juice appears to be purer and richer in acid than that of the ordinary variety. The fruits are thin skinned, very juicy, and few seeded, but they are also smaller than ordinary limes. In Dominica the spineless lime appears "better adapted for cultivation in dry localities, near the coast, than in wet or elevated districts. In the latter districts it grows with great vigour on good soils, assumes a considerable size, and is therefore more liable to be blown over by strong winds. Owing to this strong vegetative development it takes longer to come into bearing than the common spiny variety; but strength of growth, if accompanied by good fruiting qualities, is a factor of great value."

The quantity of citric acid in the juice whilst important is not the only factor to be taken into account. Investigations made in Dominica by Mr. G. A. Jones (*West Indian Bulletin* xii. 1912, 506) indicate that juice of the highest acidity will be produced under conditions of a low rainfall on a non retentive soil. On the other hand however under these same dry conditions smaller fruits, containing less juice, are frequently produced, and thus the citric acid contents of the juice of a given number of fruits from a dry or wet locality may be much the same.

W. G. FREEMAN.

LIME CONTRACT FORM.

In use at River Estate.

A beginning had been made with lime cultivation at River Estate. In 1917 the estate put in six acres and another ten is being planted this season. As already recorded in this *Bulletin* (XVII, 1918, 1) ground provisions grown amongst the young limes have repaid the cost of planting the permanent crop.

Contracts for lime and provision growing were also offered. Last year they were not favoured. The timber contracts (see p. 91) being apparently more attractive. This year however the estate example is being followed and ten acres have been taken up by contractors. The following is the form of contract. It will be noticed that it provides for successive payments at the end of each of the three years of the term of the contract.

TRINIDAD.

IN THE MATTER OF

THE AGRICULTURAL CONTRACTS ORDINANCE, No. 67.

Statutory Contract made this day of 19 .

Between Louis Seheult of Diego Martin, acting herein for and on the behalf of the Government of Trinidad and Tobago (hereinafter called the Owner) and
of (hereinafter called the Contractor) for extending the cultivation of the *River Estate*, in the Ward of Diego Martin in the Island of Trinidad.

Whereas the Contractor was on or about the
day of 19 let into possession of acre-
of land or thereabout, bounded on the North by lands of
on the South by lands of
on the East by lands of
on the West by lands of
being part of the said *River Estate* for a term of 3 years, on agreement with the Owner of the said Estate to plant the same in Lime trees and in Ground Provisions in a regular and husbandlike manner under the direction and supervision of the Owner or his Deputy.

And whereas the Owner and Contractor are desirous of bringing the said Contract within the provisions of the Agricultural Contracts Ordinance No. 67.

It is now agreed as follows:—

1. That the Contractor shall plant the said land from the date hereof in Lime trees provided by the Owner and in Ground provisions provided by himself and shall keep and maintain all of the Lime trees heretofore and henceforth to be planted in a good and husbandlike manner. Such Lime trees to be planted 20 feet by 20 feet apart. The lining to be done by the Owner or his Deputy, but the stakes or pickets required for lining such land are to be supplied by the Contractor.

2. The Contractor shall within six months of this date have the whole land regularly planted with Lime trees, or the owner may recover possession of the land.

3. The Contractor shall not plant any rice nor more than one crop of corn on the land without the consent in writing of the owner being first obtained.

4. The Contractor shall not remove or burn any grass, plants or timber or make charcoal on the land, unless the consent in writing of the Owner is first obtained: without such consent all such grass, plants and timber shall be allowed to decompose on the land.

5. The Contractor shall destroy all ants nests that may come upon the land granted under this agreement.

6. The Contractor shall on no account trim his Lime trees.

7. The Contractor shall have the full benefit of all provisions growing on the said land until the termination or cancellation of the contract.

8. The Contractor shall not erect any building of any kind whatever on the said land.

9. No cart or vehicle shall be allowed to go on the said land for any purpose or reason whatsoever, and the Contractor shall not tether or allow to graze or feed on his contract any stock such as horses, mules, donkeys, cattle, pigs, goats, etc. The Owner or any person authorised by him may have same impounded.

10. The Owner shall dig all drains that he may consider necessary at his own cost. The Contractor shall spread the earth dug therefrom at his own cost. The Contractor shall maintain and keep clean all drains.

11. The Owner or any person authorized by him shall have full power at any time to inspect the said contract and to do any work or thing which he may think fit for the benefit of the Lime trees.

12. The Owner or any person authorized by him shall have power to order out of the land any undesirable person. Should any such person refuse to quit, he shall be liable to be prosecuted under Ordinance No. 7.

13. Where the Contractor fails to do any work or thing required to be done by him, the Owner may, but shall not be obliged to do such work or thing omitted to be done, and it shall be lawful for the Owner to deduct from the monies coming to the Contractor the cost of doing such work or thing.

14. The Owner shall pay to the Contractor the sum of two cents four cents and six cents respectively for each healthy Lime tree at a date to be fixed by the Owner during the quarters ending 30th September, 19 , 19 , 19 , respectively, ⁽¹⁾ but no compensation whatever shall at any time during the subsistence of this contract or at the determination thereof be paid by the Owner to the Contractor in respect of any ground provisions.

(1.) A Contractor taking up land in the planting season of 1917 would get his first payment in September 1918. (W.G.F.)

15. The Contractor shall pay to the Owner the sum of 2, 4 and 6, cents respectively for each lime tree that shall be found damaged or missing by the Owner when inspecting the land during the quarter ending September in each of the above years respectively.

16. It shall be lawful for the Owner to deduct from the monies coming to the Contractor all monies (if any) due or owing by him to the Owner.

17. Should the Contractor be convicted of any kind of larceny, or for conveying, or being in possession of produce suspected to have been stolen, such conviction shall operate as a termination of the contract, but the Owner shall, within one month of such conviction, have the contract valued and pay to the Contractor the amount found due on or before the next regular pay day after the Contractor shall have claimed same.

18. At the termination of the contract, the Contractor shall deliver up the contract clean and free from grass or weed and in good order.

19. This contract shall continue for a term of three years from the date the Contractor was let into possession.

IN WITNESS WHEREOF the said Owner and Contractor have hereunto set their hands in the presence of

<i>Stipendiary Justice of the Peace.</i>	{	<i>Contractor.</i>
		<i>Owner.</i>

EXPLANATION OF PLATE 1.

- FIG. 1.—*Polistes canadensis* commonly called "Jack Spaniard." It is a useful insect preying on caterpillars of many species.
- FIG. 2.—*Scymnus auritulus*, enlarged. The hair line on the left of the figure indicates the natural size of the insect. This lady bird is very common and is an efficient check on aphides of all species. Colour of beetle brown.
- FIG. 3.—*Alya orbigera*, enlarged. This lady bird beetle is very common about gardens and preys principally on scale insects of various species. Colour grey with black spots.
- FIG. 4.—*Cyanopterus stirastoma*. Top figure natural size of female insect. Bottom figure ovipositor enlarged. Prey on caterpillars and larvæ of beetles which are devoured by the young larvæ of the ichneumon. Colour of insect body red with black spots.
- FIG. 5.—*Willistonina caesiens*. Slightly enlarged. A useful type of caterpillar destroyer. Colour dark grey with white rings.
- FIG. 6.—*Chrysopa* sp. Larval stage enlarged. The larvæ of this insect cover themselves with the skins of their victims and little bits of rubbish.
- FIG. 7.—Caterpillar of the moth *Attacus hepereus*.
- FIG. 8.—Caterpillar of the moth *Albatus argillacea*.
- Figs. 1, 2, 3 are by Mr. Horace Knight, 4 and 6 by Mr. P. L. Guppy and 5, 7 and 8 by Mr. W. Butth.
- Figs. 7 and 8 are types of chewing insects.

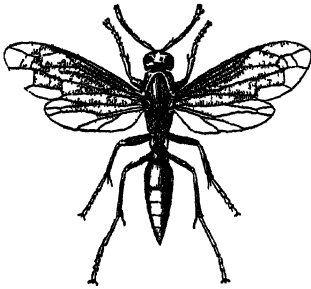


FIG. 1.—*Polistes canadensis*



FIG 2
Lady bird beetle.



FIG 3 —*Lady bird beetle*

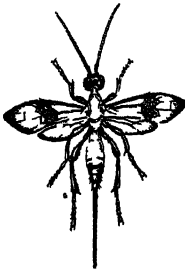


FIG 4 — *Ichneumon*



FIG 5 — *Tachina fly*

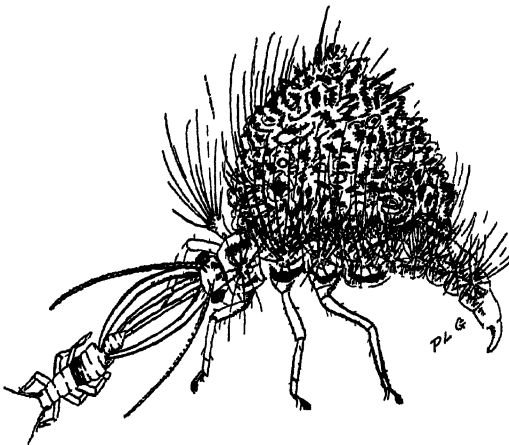


FIG 6 — *Larva of lace wing fly*



FIG 7 — *Catepillar*

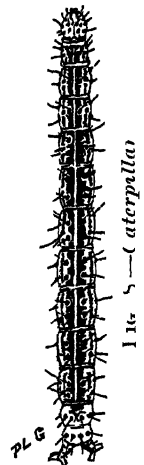


FIG 8 — *Aterpallus*

EXPLANATION OF PLATE 2.

FIG. 9.—*Steirastoma depressum*. Natural size colours black and grey.

FIG. 10.—*Schistocerca paranensis*. Natural size. Colours tawny with black spots on wings.

FIG. 11.—*Laphygma frugiperda* showing:—

1. Egg side view, enlarged.
- 1a. and 1b. Egg mass on leaves.
2. Funnel of corn cut open to show A rolled up leaf, B caterpillar coiled up, C excrement of caterpillar.
3. Newly hatched caterpillar greatly enlarged.

FIG. 12. *Laphygma frugiperda* showing details of structure of a full grown caterpillar slightly enlarged.

All insects figured on this plate are types of chewing insects.

Figs. 9, 11 and 12 by Mr. P. L. Guppy. Fig. 10 by Mr. W. Buthn.

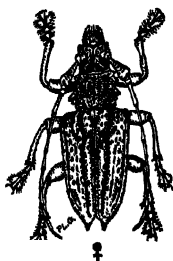


FIG. 9.—*Cucuo beetle*.

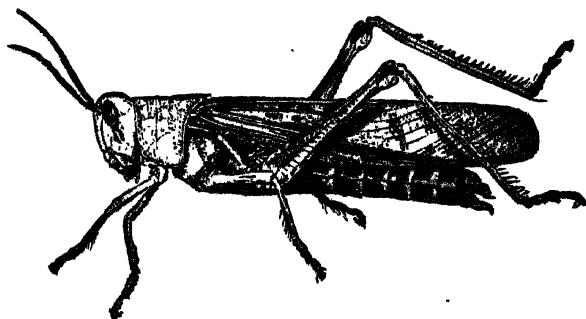


FIG. 10.—*Venezuelan locust*.

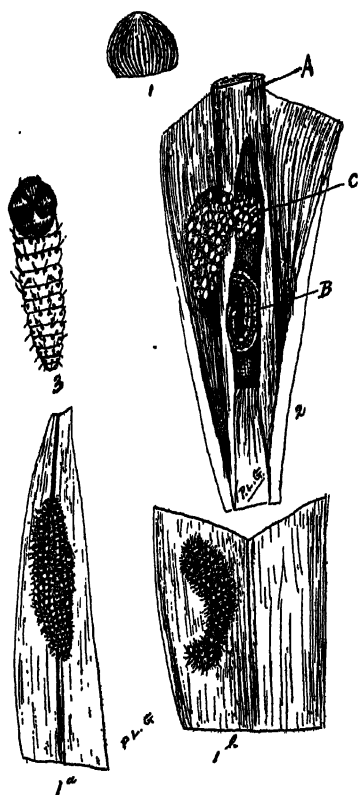


FIG. 11.—*Corn caterpillar*.

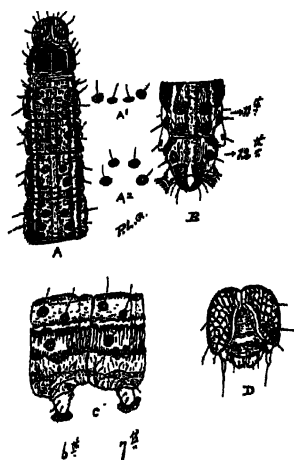


FIG. 12.—*Corn caterpillar*.

EXPLANATION OF PLATE 3.

Fig. 13.—*Tachardia gemmifera* Scale insect :

- a. young or crawling stage.
- b. feeler or antenna of above.
- c. leg of above.
- d. A single scale fully formed top view.
- e. & f. Do. do. side views.
- g. A scale not quite formed.

All above figures enlarged.

- h. Scale attached to stem of plant natural size. Colour of scales carmine.

FIG. 14.—*Hypsilonotus fulvus* side view, slightly enlarged showing
A head, B eye C thorax, D wings, E abdomen and F proboscis
or sucking mouth part.

FIG. 15.—*Hypsilonotus fulvus*. Enlarged. Colours tawny with black
spots and rings.

All insects on this plate are types of sucking insects.

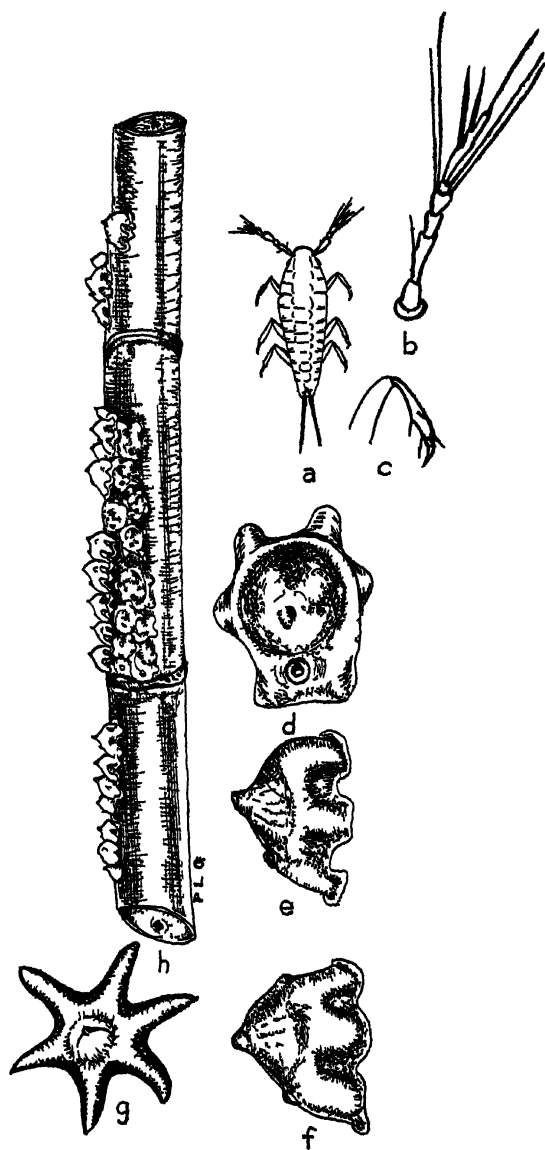


FIG 13.—Scale Insect

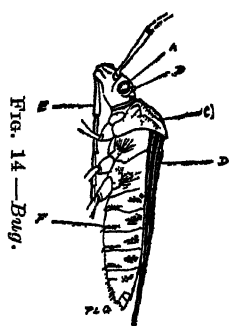


FIG. 14—Bug.

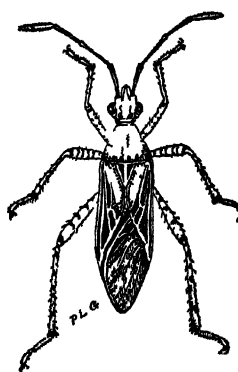


FIG 15—Bug

EXPLANATION OF PLATE 4.

FIG. 16.—Top figures aphides or plant lice, bottom figures (*Cycloneda sanguinea* larva on left and adult beetle on right. All figures enlarged. Colour of plant lice black, of larva and beetle red and black. The beetles act as efficient natural checks on the plant lice.

FIG. 17.—*Corythuca* sp. A delicate light brown insect, greatly enlarged.

FIG. 18.—*Strategus julianus*. One of the so-called hard back beetles, natural size. Colour shining dark brown.

FIG. 19.—*Megilla maculata*. Enlarged. Colour black and red. Natural enemy of aphides.

FIG. 20.—*Bruchus* sp. enlarged. Colour grey and black.

FIG. 21.—*Epitrix pilosa*. Enlarged. Colour black.

Fig. 16 by Mr. P. L. Guppy.

Fig. 17 by Mr. W. Buthn. Figs. 18-21 by Mr. Horace Knight.

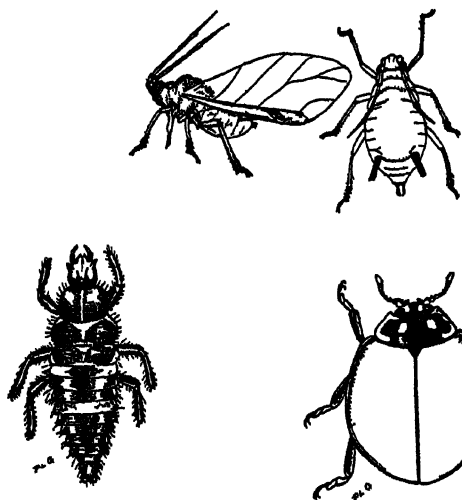


FIG. 16.—*Aphides & natural enemies*

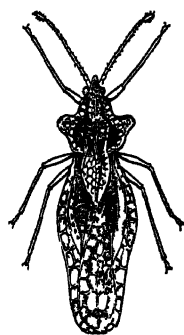


FIG. 17.
Lace wing bug.

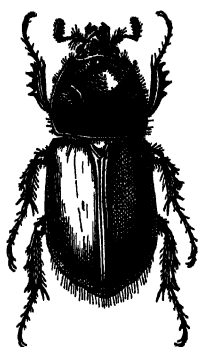


FIG. 18.—*Hard back.*

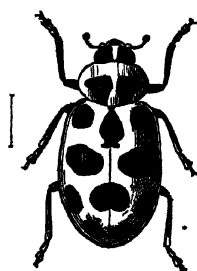


FIG. 19.
Lady bird beetle.



FIG. 20.
Pigeon pea weevil.

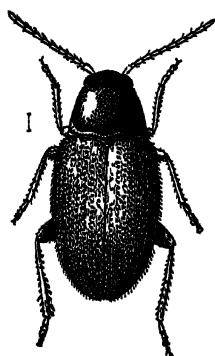


FIG. 21.—*Flea beetle.*

PLANT DISEASES AND PESTS.

SOME OF THE PRINCIPAL INSECTS AFFECTING VEGETABLES IN TRINIDAD AND TOBAGO.

By F. W. URICH.

Entomologist, Board of Agriculture.

VEGETABLES of all kinds, whether grown in open fields, gardens or back-yards are affected by insects some of which are useful and others injurious. These notes have been prepared in order to call the attention of the grower to some of the principal pests of vegetables.

For convenience of reference the notes on the chief pests of each crop have been grouped under the name of the crop; the first column gives the name and information as to importance of the pest, the second describes how it damages the plant, and the last column gives directions as to treatment. A cultivator should thus be enabled to find out easily what pests he has and how to deal with them. He should bear in mind that crop production is increased by crop protection.

AGRICULTURAL OPERATIONS WHICH TEND TO KEEP DOWN INSECT PESTS.

Insects can be kept down to some extent by the following :—

1. Clean cultivation and removal of all weeds before planting up—many pests of cultivated plants live on weeds.
2. Forking, as it destroys or exposes to attacks by birds and lizards, mole crickets and other soil inhabiting insects.
3. Removal of crop remnants; as soon as a crop has been reaped clear away the parts which are of no further use.
4. Changing season for planting when practicable. Some insects thrive best in one season, for instance caterpillars are numerous in the wet season and scale insects in the dry season.
5. Rotation of crops; do not plant the same crops on the same beds year after year but vary as much as possible.
6. Stimulate growth by manuring and mulching. (1)

NATURAL ENEMIES.

All insects in a garden are not injurious, on the contrary many are exceedingly useful friends. Among them the following are commonly seen: Jack Spaniards or *Polistes* live on caterpillars of all kinds which they kill for food see Fig. 1; Lady bird beetles see Figs. 2 and 3 and 19 which prey on plant lice (aphides) and scale insects; hymenopterous parasites some of which prey on all stages of insects see Fig. 4, tachina flies see Fig. 5 attacking caterpillars of all kinds; lace wing flies see Fig. 6 devouring in their larval stages thrips, scale insects and plant lice.

Besides insects the grower has valuable allies in toads, lizards and birds all of which should be protected.

(1) For general information on the Cultivation of Vegetables see the pamphlet *Our Local Foods their Production and Use*, issued by the Department of Agriculture.

SPRAYING MIXTURES AND THEIR APPLICATION.

Insecticides may be divided into two groups according as to whether they are for use against biting insects or sucking insects. Figs. 7, 8, 9 and 10 show some types of biting insects while Figs. 13, 14 and 15 illustrate those belonging to the sucking group.

INSECTICIDES FOR BITING INSECTS.

(1.) **ARSENATE OF LEAD**.—Arsenate of lead is sold in two forms, viz: in paste and dry. In making up solutions mix the arsenate of lead into a thin paste with a little water before adding the full quantity.

Paste.—For use take

Arsenate of lead paste	...	3-5 pounds.
Water	... ..	50 gallons.

For small quantities take:

Arsenate of lead paste	...	1 lb.
Water (a pitch oil tin full)	...	5 gallons.
or Arsenate of lead paste	...	1 table spoonful.
Water	... ..	6 quart bottles.

Dry.—Arsenate of lead powder should be used in the proportion of 1 to 4 lb. powder to 50 gallons water. It may also be used for dusting in which case it should be mixed with flour, air slaked lime or wood ashes for use take 1 lb. arsenate of lead powder to 2 or 3 lb. of lime, flour or ashes.

(2.) **PARIS GREEN**.—Paris Green is a useful stomach poison and is quick in killing insects, but it has the disadvantage of burning foliage if not properly mixed or if applied too thickly.

<i>Dry application</i> —Paris green	... ..	... 1 lb.
Dry well sifted white lime,		... 6 lb.
flour or road dust.		

Mix Paris green and lime thoroughly, place in a muslin bag and shake gently over the plants.

<i>Wet application</i> —Paris green	... ..	... 4 ounces.
Temper lime	... ..	... 1 lb.
Water	... ..	... 50 galls.

(3.) **BRAN MASH**.—

Bran	... ..	... 25 pounds.
Paris green	... ..	... $\frac{1}{2}$ pound.
Molasses	... ..	... 1 quart.

Water as needed for moistening.

Mix bran and Paris green dry. Prepare molasses by dissolving in water and use this for moistening Bran and Paris green mixture.

For small quantities use:

Bran	... ..	... 1 quart.
Paris green	... ..	... 1 teaspoonful.
Molasses	... ..	... 1 tablespoonful.

Water as needed to moisten.

(4.) *PARIS GREEN AND FLOUR FOR MOLE CRICKETS.*

Paris green	..	...	...	... 8 lb.
Flour ...	...	...	...	... 100 lb.

Mix dry for use *see* Insect No. 22 page 87.

INSECTICIDES FOR SUCKING INSECTS.(5.) *RESIN WASH. (U.S. Dept. of Agr. Formula) STOCK SOLUTION.*

Powdered Resin	...	...	...	... 10 lb.
Caustic soda	...	...	...	... 2½ "
Whale oil	...	...	...	... 20 ounces
Water	...	...	...	... 5 gallons.

The first two ingredients are placed in a kerosene oil tin with a gallon of water. Boil until the resin is melted then add Whale oil. Boil until liquid has a dark brown colour. From one to two hours will be necessary. Care should be taken that the liquid does not boil over and when water is added it should be poured in slowly and thoroughly mixed. Before taking off from fire add water and fill tin.

For use take one bottle (quart) of this stock and add to a kerosene tin full of water. This forms a strong solution that will kill most insects and not injure plants. When used hot it is more effective. Weaker solutions can be used according to the insects to be killed.

(6.) *NICOTINE SULPHATE OR BLACK LEAF 40.*—Nicotine sulphate is a ready made insecticide of an excellent quality. It has good killing qualities and does not burn foliage easily. The labels of the makers give full directions for mixing. The following mixture will be useful for most insects of the vegetable garden.

Black Leaf 40	...	...	...	1½ teaspoonfuls.
Water	...	...	...	1 gallon.
Soap	...	..	...	1 ounce.

Black leaf 40 can be added to Bordeaux mixture and Resin wash.

(7.) *SOAP.*—A soap solution will kill many soft bodied insects and may sometimes be preferred for ease in preparing an insecticide in a hurry.

For use take ordinary brown or blue soap and dissolve 1 lb. in four or five gallons of water. If the water is used hot the spray will be more effective.

(8.) *PYRETHRUM POWDER.*—When not safe to use arsenicals on account of plants intended for food, pyrethrum may be substituted as it is harmless to man or animals. Obtain the powder as fresh as possible and dust the plants liberally with it undiluted.

(9.) *BORDEAUX MIXTURE.*—Bordeaux mixture is a standing fungicide and its use in the vegetable garden will not only prevent fungoid pests, but it will also act as a good insect repellant. It mixes well with

arsenate of lead, resin wash and Black leaf 40 and when thus combined becomes an excellent insecticide as well. For preparing large quantities take

I.—Blue stone	...	...	...	5 lb.
Water	...	...	...	25 galls.
II.—Fresh temper lime	...	...	...	5 lb.
Water	...	...	...	25 galls.

When I and II are well dissolved mix by pouring together in a suitable barrel and thus make up 50 gallons of mixture.

For use against sucking insects add

- (a.) from 4 to 8 ounces of nicotine sulphate or Black leaf 40 to every 50 gallons of mixture.
- (b.) from 6 to 10 quart bottles of resin wash to every 50 gallons mixture.

For use against biting insects add

- (c.) 4 lb. Arsenate of lead paste to every 50 gallons of mixture.

For preparing small quantities of Bordeaux mixture take

I.—Blue stone	...	...	...	8 ounces.
Water	...	...	...	5 bottles.
II.—Fresh temper lime	...	...	...	8 ounces.
Water	...	...	..	5 bottles.

Mix I and II by pouring together into a suitable vessel.

STICKER FOR BORDEAUX MIXTURE.—When the mixture is used on plants with very waxy surfaces such as cabbage or cassava a sticker should always be added. Resin wash will serve the purpose when added in the proportion of 1 quart stock to every 50 galls. of mixture or the following may be used :—

Powdered Resin	...	...	...	2 pounds.
Washing soda	...	...	...	1 pound.
Water	...	...	...	2 quarts.

Boil above until a clear brown solution is obtained.

Use at the rate of 1 quart for every 50 gallons of bordeaux mixture.

MEASURES USED IN CONNECTION WITH ABOVE FORMULÆ.

8 Teaspoonfuls	..	...	...	1 fluid ounce.
16 fluid ounces	...	...	...	1 pint.
8 pints	...	...	...	1 gallon.

Full directions for preparing Bordeaux mixture will be found in *Circular No. 4* of the Board of Agriculture by J. B. Rorer.

Some of the principal Insects of Vegetables grouped under the crops affected.

INDIAN CORN.

Insect and Status.	Part of Plant attacked and appearance of damage.	What to do and when to do it.
(1.)—CORN CATERPILLAR OR CORN WORM— <i>Laphygma frugiperda</i> . Very common and injurious. See Figs. 11 and 12.	Leaves and ears. The developing leaves are eaten and appear jagged and perforated. When the ears develop parts are eaten out and the whole ear is lost.	Spray or dust with arsenical as soon as the damage is noticed. The caterpillar feeds inside the funnel. Use arsenate of lead paste 1 lb. in 10 galls. water or dust with powdered arsenate of lead mixed with two or three times its weight of slaked lime, wood ashes, starch or flour, the last two being preferable.
(2.)—MOTH BORER— <i>Diatrasa saccharalis</i> . Uncommon, sometimes isolated outbreaks. The caterpillar is about one inch long, light coloured with black spots.	Young unfolded leaves are attacked but the stems are the parts most affected. The caterpillars are internal feeders and perforate the stem in the interior of which they live. Excrement is pushed out of a small hole in the stem and the accumulation of it betrays the caterpillar.	When young, the caterpillars would be killed by arsenicals, but when in the interior of the stems they are hard to get at and are best left to natural enemies, as cutting on a large scale would hardly pay.
(3.)—LEAF HOPPERS: <i>Peregrinus maidis</i> . Small sucking insects generally attended by ants.	Found between the leaves of the funnel and attacking them by sucking out the juices. In severe infestations the leaves turn yellow. Also found on developing ears.	As a rule there are not many plants affected and generally old stand-overs serve as breeding places. First destroy the attending ants, and if infestation is very bad, cut out and burn the plant.
(4.)—APHIDES OR PLANT LICE: small black sucking insects. See Fig. 16.	The plant lice cluster in numbers on young leaves and cause them to curl and turn yellow.	As a rule the plant lice are controlled by natural enemies. When first noticed, the leaf should be removed from the plant and burnt.

SWEET POTATOES.

Insect and Status.	Part of plant attacked and appearance of damage.	What to do and when to do it.
(5.) STEM BORING CATERPILLAR of the moth <i>Megastes grandalis</i> . Fairly common and injurious; a light coloured caterpillar with dark spots about 1½ inches long.	In the young stage the caterpillar enters the stem and gradually eats it out working towards the ground. When the stems can supply no more substance, it attacks tubers and perforates them with numerous tunnels. The stem near the ground is swollen and shows holes from which pellets of excrement are pushed out and lie about the ground. The leaves of attacked vines turn yellow.	As the caterpillars are internal feeders they are very difficult to get rid of when in the stem. When planting, select cuttings free from caterpillars and soak in Bordeaux mixture to which is added 1 lb. of arsenate of lead paste to every 10 galls. of mixture. Before tubers are formed, spray the vines occasionally with Bordeaux. If infestation has been very bad do not replant potatoes in same field.

YAMS.

(6.) CUTWORMS or caterpillars — <i>Prodenia</i> sp. Not common, and injurious only occasionally.	Young shoots are cut off at the ground level and leaves eaten off.	See No. 1.
(7.) MEALY BUGS AND SCALE INSECTS attended by ants. Not common. Small white insects, mealy bugs are cottony and the scales are like small white pellicules. Both suck the juices from the plant.	The bugs live on the tubers and are attended by stinging ants, which will be observed building up mounds of earth around the stem of the plants.	As a rule, few plants are affected, and it is best to get rid of the plant affected as soon as observed.

TANNIAS.

(8.) LACE-WING Bugs — <i>Corythuca gossypi</i> . Not common. Small delicate bugs with lace-like wings.	All stages of the bugs are found on the underside of the leaves from which they extract the sap and cause the leaf to turn yellow in the places attacked. In a heavy infestation the whole leaf will be discoloured and the underside will be studded with numerous small black specks.	As soon as observed, the leaf containing the first colonies of the insects should be cut off and burnt. Attacks are few and far between.
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TANNIAS.—Continued.

Insect and Status.	Part of plant attacked and appearance of damage.	What to do and when to do it.
(9.) HARD BACKS.—Not common. Black hard back beetles: <i>Strategus</i> sp. See Fig. 18.	Tubers are attacked and ruined by the beetles and the leaves die.	Little can be done to prevent the attacks, but as they are not numerous the affected tubers should always be dug out and the beetles destroyed when observed.

PIGEON PEA.

(10.) CATERPIL- LARS of the moth <i>Ancylotomia stero- cerca</i> . Occasion- ally very bad. Small green cater- pillars about $\frac{1}{2}$ inch in length.	The green pods are per- forated by the caterpillars which eat the young peas.	Little can be done to prevent attacks. The caterpillars are partly controlled by natural enemies. Infected peas should be picked and burnt at the opening of the season.
(11.) WEEVILS. — <i>Bruchus</i> sp. and <i>Bruchus chinensis</i> , small brown and grey beetles. Fair- ly common. See Fig. 20.	The peas in the pod when dry are attacked. The larvæ live in a single pea and hollow it out. The peas are infected in the field, but the weevils go on breeding when the peas are in storage.	Dry pods should not be left on the trees too long, and before the peas are put into storage they should be fumigated with carbon bisulphide or ant poison, by being placed in an air-tight box and using 8 tea-spoonfuls of the chemical for every bag of peas and for a period of 24 hours. Peas intended for seed pur- poses should not be fumi- gated for longer than 12 hours, and must always be aired before being put away.

EGG PLANT OR MELONGENE.

(12.) LACE - WING Bugs. <i>Corythuca</i> . Small delicate in- sects. If neglected can become very serious pests. See Fig. 17.	The insects in all stages of development live on the underside of the leaves from which they suck the sap. Affected leaves turn yellow in parts and when the insects are numerous, they turn black or brown as if scorched.	As soon as the insects are noticed the leaf on which a colony starts should be cut off and burnt. Spray with Bordeaux as a pre- ventative, and when insects are numerous, use any good contact insecti- cide, such as nicotine sulphate or resin wash.
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EGG PLANT OR MELONGENE.—*Continued.*

Insect and Status.	Part of plant attacked and appearance of damage.	What to do and when to do it.
(13.) FLEA BEETLES: <i>Epitrix</i> . Small black jumping beetles which look like fleas. If neglected they can become serious pests. See Fig. 21.	The beetles eat minute holes in the leaves, which appear as if perforated by small shot. As the attack proceeds the holes increase in size and number, and a leaf presents the appearance of lace work.	As soon as the first signs of the beetles are noticed the entire plant should be sprayed with Bordeaux mixture to which is added 1 lb. of arsenate paste to every 12 gallons of mixture.
(14.) SCALE INSECTS. <i>Saissetia</i> : several species. These sucking insects can be seen on the stems of the plants and look like small black or brown oval pads about $\frac{1}{8}$ inch in diameter, usually attended by stinging ants.	The scales are attached to the stem of the plant, from which they suck the sap. In the young stages they crawl about and spread. In bad attacks they will kill the plants.	As soon as noticed, spray with a good contact insecticide, such as resin wash, nicotine sulphate. These scales require the use of a fairly strong solution to be killed.
(15.) MEALY BUGS <i>Pseudococcus</i> . Small soft and white insects, occurring in white masses on the plants.	The mealy bugs are found on the young stems near the leaf axils and at the roots of the plants, generally attended by ants.	Same treatment as for No. 14.

TOMATOES.

(16.) CATERPILLARS of the moth <i>Protoparce sexta</i> . Green caterpillars about 2 inches in length with oblique white stripes on sides. Not very numerous.	The caterpillars eat the leaves of the plants and are generally found at the end of the branches on the underside.	As soon as observed, they should be picked off and destroyed. A fairly large proportion are destroyed by small parasites.
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TOMATOES.—Continued.

Insect and Status.	Part of plant attacked and appearance of damage.	What to do and when to do it.
(17.) LACE-WING BUG. <i>Corythuca gossypi</i> . Same species attacking tannia. See No. 8.	Leaves in much the same way as No. 12.	Same as No. 12.
(18.) CUTWORMS or caterpillars of the moth <i>Prodenia</i> sp.	The caterpillars eat into green and ripening fruit, leaving large holes.	See No. 28.

CABBAGE.

(19.) CATERPILLARS of the butterfly <i>Pieris monustre</i> . Colour of caterpillars light green with minute black dots about 1-1½ inches long. Bad if neglected.	The caterpillars eat large holes in the leaves.	If the infestation is not severe the caterpillars can be picked off, but if numerous, the cabbages can be sprayed with arsenate of lead before the heads have formed. Use 1 lb. arsenate of lead paste to 12 gallons water to which a sticker composed of resin soap must be added. When the heads are formed dust with pyrethrum powder.
(20.) CATERPILLARS of moth <i>Hellula</i> sp. Small yellowish caterpillars about ½ inch long. At times injurious to young plants.	When young plants are planted out they are attacked by the caterpillars which eat holes in the leaves and spin webs in which they retire.	Same treatment as No. 19.

ATTACKING MOST CROPS.

Insect and Status.	Part of plant attacked and appearance of damage.	What to do and when to do it.
(21.)—ANTS, too well known to need description including PARASOL ANTS AND STINGING ANTS.	Parasol ants cut leaves and flowers of the plants attacked. Stinging ants encourage and foster sucking insects of all kinds such as scale insects, aphides and leaf hoppers; they also gnaw into the soft tissues of melongene, lime and other plants; recently sown seeds of some plants are carried off to the nests. They also make mounds around the stems of the plants and hamper growth.	<p>For parasol ants the treatment with carbon bisulphide is too well known to require description. Other treatments are boiling water and puddling when nests are not situated in masonry. If a little resin wash is added to the boiling water it will make the treatment far more effective. Cyanide of potassium is also effective. For use take one ounce of the salt and dissolve in one gallon of water: pour the solution into the nest until the ground is saturated. When using cyanide bear in mind that it is a deadly poison. Carbon bisulphide and cyanide will kill plants when the roots are touched.</p> <p>Stinging ants can be killed by carbon bisulphide and cyanide as mentioned for parasol ants. When on the roots and stems of plants they can be sprayed with hot resin wash, but frequent applications may be required as they return very soon from neighbouring nests. Trees can be protected by banding the stems and trunks with tree tanglefoot. Naphthalene flakes dusted around a plant will keep away ants for a few days.</p> <p>Stinging ants are common in most gardens and will require constant attention. A good method is always to have traps about and kill the ants regularly. Efficient and attractive traps consist of bones of beef, fowl and fish as they come from the table. Put out in the garden they will soon attract the ants, which may be killed by dipping the bones in boiling water. These baits will also help in locating nests.</p>

ATTACKING MOST CROPS.—*Continued.*

Insect and Status.	Part of plant attacked and appearance of damage.	What to do and when to do it.
(22.) — M O L E CRICKETS. Well known, widely distributed.	The mole cricket lives under the ground and feeds from below attacking young plants and their roots. When the plant is very young and tender the whole of it may be pulled into the soil.	Mole crickets are more troublesome in the dry season. Apply poisoned bait to the land after cleaning up and about a week before the crop is planted out. The bait is prepared by mixing dry flour and Paris green in the proportion of 3 per cent. Paris green. The bait is applied broadcast and thinly over the bed, allow one week to elapse before planting up. Growing plants can be protected by making a ring of the poison around them in a shallow trench about one inch deep and three inches away from the stem. Use a teaspoonful for each plant.
(23.)—CUT WORMS or caterpillars of <i>Prodenia</i> and allied species. Dark smooth caterpillars about 1½ ins. long. Feed at night, and during the day hide under leaves, clods of earth, &c. Occasionally injurious and in numbers.	Young plants are eaten off level with the ground; the leaves and fruit are eaten. Tomato fruit are very often attacked.	As the caterpillars live on a variety of wild plants thorough cleaning up is essential. Spray surrounding vegetation with arsenate of lead before planting out crops. Protect vegetable plants with poisoned bran mash placed near them on the ground, apply late in the afternoon.

RUBBER.

RUBBER TAPPING EXPERIMENTS, 1917-18.

TAPPING INTERVAL.

The tapping interval experiments with Para rubber (Hevea) at St. Clair Experiment Station which were commenced in 1911 have been continued during the year. The object of the experiment is to determine whether it is not more profitable to tap the trees at longer intervals than two days. This question has already been discussed by me in an article "Notes on the Tapping of Para Rubber" (*Bulletin Department of Agriculture* XV, 1916, 155-64) extracts from which were reproduced in the Report of the Rubber Committee (*Bulletin* XVI, 1917, 109-12) in which the previous yields were summarised.

The results continue to show that very satisfactory yields are obtainable even under the comparatively dry conditions of St. Clair Experiment Station. The trees were tapped from the middle of February 1918, a period of seven months, on the half herring-bone system on a quarter of the trunk. The half herring-bone was continued because the experiment was started with it and changes are not desirable. In more recent experiments more modern systems are employed. The yields per tree were as follows:—

Series A. tapped every other day	...	8 lb. 0 oz.
B. " fourth day	...	2 lb. 9 oz.
E. " sixth day	...	1 lb. 14 oz.

As in previous years tapping every sixth day is far below the others and the interval here is evidently too long for remunerative returns.

During the last three years the yields per tree in series A (alternate day tapping) have been 8 lb. 13 oz., 8 lb. 7 oz. and 8 lb.—an average of 8 lb. 7 oz. per tree per year. For series B (tapping every four days) during the same years the figures are 8 lb. 14 oz., 8 lb. 6 oz. and 2 lb. 9 oz. or an average of 8 lb. 5 oz. per tree per year.

In this experiment series A. with double the number of tappings has only given two ounces more per tree as compared with series B. As tapping in this Colony is the largest item of expenditure in rubber production, amounting to \$40.00 per acre in Mr. E. A. Robinson's figures from estate experience (*Bulletin* XIV, 1915, 118-9) the advantage from a financial point of view lies clearly with tapping every fourth day. It will be of great importance to have similar tests made on an estate scale and under other climatic conditions, and I am glad to report that Mr. E. A. Robinson proposes to experiment along these lines this year.

TAPPING OF YOUNG TREES.

At St. Augustine Experiment Station there are two acres of Hevea; one acre Hevea alone and the other Hevea and cacao. In both the rubber trees are planted 24 feet by 24 feet or 75 to the acre. They were six years old early in 1917. Their girths were taken and the trees which were 20 inches at 8 feet from the ground selected for tapping. The results are of interest as indicating what can be obtained from trees of about the minimum age and girth, growing in a comparatively dry and exposed locality.

Only very light tapping was done, every fourth day on a single cut extending one-quarter round the trunk 18 inches from the ground. The all rubber plot, contained 28 trees of the minimum girth (20 inches) and these, called series P, gave an average of 6.80 oz. per tree in six months tapping. (Middle of August to middle of February).

The rubber and cacao plot contained 19 tappable trees and their average yield during the same period was 7.60 oz. per tree, series Q. The number of tappings was the same for both series.

In the coming season it is proposed to use these two groups for another tapping-interval experiment and to tap series P. every other day whilst continuing to tap series Q. every fourth day.

TRANSPORT OF LATEX.

In view of the suggestion in the Rubber Committee's Report of central factories and transporting latex from a distance, it is interesting to note that the rubber from St. Augustine was made up at St. Clair, the latex being sent in about eight miles, by the Government Farm milk cart daily, with fair results. Up to the present the chief trouble has been partial coagulation on the journey, increasing the proportion of scrap rubber obtained and resulting in a poorer grade of biscuit.

I am indebted to Mr. R. O. Williams for keeping the daily records of latex and dry rubber obtained in each series, and for compiling the results at the end of the season.

W. G. FREEMAN.

GOOD GROWTH OF HEVEA IN THE MORUGA ROAD DISTRICT.

In Appendix C to the Report of the Rubber Committee (*Bulletin Department Agriculture* XVI, 1917, 132-3) a summary was given of measurements taken by the Committee of rubber trees of known ages in various parts of the Colony. Since the publication of the Report information has been received of the existence of well grown trees in the Moruga Road District, about half way between Princes Town and the South Coast, on two estates from which no return had previously been made. These have recently been examined and found to be, for their age, the best grown specimens of Hevea as yet known in the Colony. At Sims Vale Estate, the property of Mr. R. S. de Silva, there are some 3,000 to 4,000 Hevea trees, the age of the oldest being seven years. They were planted amongst young cacao, 24 feet apart, in rows alternating with rows of Immortels at similar distances. The land is undulating with fairly steep slopes. The soil varies but on the hills is a yellow sandy loam, baking hard on the surface in the dry season.

The following measurements taken without any selection on May 18, 1918, give dimensions in inches at three feet from the ground :—

A. *On top of ridge* :—33½, 26, 30, 24, 24, 37½, 29½, 27—*Average 29.*

B. *Upper slope of another Field* :—38, 40, 30, 30, 26, 40, 40, 34, 30, 36, 35, 32—*Average 34.*

C. *Bottom land of above Field (B)* :—35, 36, 27, 25, 32, 26, 34—*Average 30½.*

The general average for the twenty-seven trees measured was 31·7 or approximately 32 inches. Age 7 years.

The good growth made by these trees is shown by comparison with the average girths already published of trees of the following ages.

Seven Years : St. Augustine Experiment Station—19 inches.

Dos Hermanos, Sangre Grande—15 inches.

Eight Years : Palmiste, Naparima—9 to 16½ inches, under various conditions.

Nine Years : Palmiste—15½ to 17 inches, Concord, Pointe-à-Pierre—

9½ to 23 under various conditions ; Eureka, Peñal—

28 ; Non Pareil, Sangre Grande—31 ; Verdant Vale,

Arima—29 ; Newlands, Sangre Grande—27 inches.

Ten Years : Roxburgh, Tobago—35 inches.

Thirteen Years : St. Clair Experiment Station—24 inches.

Eighteen Years : St. Clair Experiment Station—34½ inches.

Close to Sims Vale Estate is Santa Catalina, the property of the Heirs of Toppin. Here also are Hevea trees scattered through the cacao. In a hurried visit, time only allowed to visit one group of six trees on the top of a ridge where the cacao had died out. Their age is about nine years ; their dimensions 40½, 32, 32½, 39, 29, 26, an average of 33 inches.

At Sims Vale Estate preparations are being made for tapping some 2,000 trees this year. The results will be of great interest. If the yield of the trees is as good as their growth would lead one to expect the cultivation of Hevea should prove a remunerative industry in this district, where during recent years some of the cacao has suffered so severely from drought and troubles such as die-back, cacao beetles, etc., which assume serious proportions in places, or during seasons, which are not ideal for cacao.

W. G. FREEMAN.

FORESTRY.

TIMBER-GROWING CONTRACT FORM.

In use at River Estate.

IN order to encourage the cultivation of ground provisions, meet the desires of residents for land, and at the same time get useful timber trees planted, the Department in 1917 offered contracts for timber and ground-provision cultivation on a portion of the hill-lands of River Estate. The trees to be planted are British Honduras Mahogany (*Swietenia macrophylla*), Cedar (*Cedrela odorata*), and Cypre (*Cordia gerascanthoides*). The offer has been well taken up and 75 acres are now under cultivation by some 60 contractors. The following is the form of contract, with necessary explanatory words in italics in brackets :—

TRINIDAD.

IN THE MATTER OF

THE AGRICULTURAL CONTRACTS ORDINANCE, No. 67.

Statutory Contract made this

day of 191 .

Between Louis Seheult of Diego Martin, acting herein for and on the behalf of the Government of Trinidad and Tobago (hereinafter called the Owner) and

of (hereinafter called the Contractor) for extending the cultivation of the *River Estate*, in the Ward of Diego Martin in the Island of Trinidad.

Whereas the Contractor was on or about the day of 19 let into possession of acre of land or thereabout, bounded

on the North by lands of
on the South by lands of
on the East by lands of
on the West by lands of
being part of the said *River Estate* for a term of (*five*) years, on agreement with the Owner of the said Estate to plant the same in trees and in Ground Provisions in a regular and husbandlike manner under the direction and supervision of the Owner or his Deputy.

And Whereas the Owner and Contractor are desirous of bringing the said Contract within the provisions of the Agricultural Contracts Ordinance, No. 67.

It is now agreed as follows :—

1. That the Contractor shall plant the said land from the date hereof in trees provided by the Owner and in Ground provisions provided by himself and shall keep and maintain all of the trees heretofore and henceforth to be planted in a good and husbandlike manner. Such trees to be planted (10) feet by (10) feet apart. The lining to be done by the Owner or his Deputy, but the stakes or pickets required for lining such land are to be supplied by the Contractor.

2. The Contractor shall within (*six*) months of this date have the whole land regularly planted with _____ trees, or the Owner may recover possession of the land.

3. The Contractor shall not plant any rice nor more than one crop of corn on the land without the consent in writing of the Owner being first obtained.

4. The Contractor shall not remove or burn any grass, plants or timber, or make charcoal on the land, unless the consent in writing of the Owner is first obtained; without such consent all such grass, plants and timber shall be allowed to decompose on the land.

5. The Contractor shall destroy all ants nests that may come upon the land granted under this agreement.

6. The Contractor shall weed or cutlass his contract four times a year, in February, May, August and November and supply the missing trees at each weeding or cutlassing. The Contractor shall use all grass, bush and weeds cutlassed or weeded for the purpose of mulching the said land.

7. The Contractor shall on no account trim his _____ trees.

8. The Contractor shall have the full benefit of all provisions growing on the said land until the termination or cancellation of the contract.

9. The Contractor shall not erect any building of any kind whatever on the said land.

10. No cart or vehicle shall be allowed to go on the said land for any purpose or reason whatsoever, and the Contractor shall not tether or allow to graze or feed on his contract any stock such as horses, mules, donkeys, cattle, pigs, goats, etc. The Owner or any person authorised by him may have same impounded.

11. The Contractor shall cut out all bird vine that may come upon the trees in his contract.

12. The Owner or any person authorised by him shall have full power at any time to inspect the said contract and to do any work or thing which he may think fit for the benefit of the _____ trees.

13. The Owner or any person authorised by him shall have power to order out of the land any undesirable person. Should any such person refuse to quit, he shall be liable to be prosecuted under Ordinance No. 7.

14. Where the Contractor fails to do any work or thing required to be done by him, the Owner may, but shall not be obliged to do such work or thing omitted to be done, and it shall be lawful for the Owner to deduct from the monies coming to the Contractor the cost of doing such work or thing.

15. At the termination of the contract, the Owner shall pay to the Contractor for each healthy well grown _____ tree not less than (*five*) years old the sum of (*twelve cents*) and for each younger healthy well grown _____ tree not less than (*three*) years old the sum of (*six cents*).

16. The Contractor shall pay to the Owner the sum of (*twelve cents*) for each missing _____ tree which had not been supplied at least six months before the termination or cancellation of the agreement.

17. It shall be lawful for the Owner to deduct from the monies coming to the Contractor all monies (if any) due or owing by him to the Owner.

18. Should the Contractor be convicted of any kind of larceny, or for conveying, or being in possession of produce suspected to be stolen, such conviction shall operate as a termination of the contract, but the Owner shall, within one month of such conviction have the contract valued and pay to the Contractor the amount found due on or before the next regular pay day after the Contractor shall have claimed same.

19. At the termination of the contract, the Contractor shall deliver up the contract clean and free from grass or weed and in good order.

20. This contract shall continue for a term of (*five*) years from the date the Contractor was let into possession.

IN WITNESS WHEREOF the said Owner and Contractor have hereunto their hands in the presence of

Stipendiary Magistrate.

Contractor.

Owner.

PERMITS FOR REMOVAL OF TIMBER.

RULES MADE BY THE GOVERNOR IN EXECUTIVE COUNCIL UNDER THE PROVISIONS OF SECTION 23 OF THE FORESTS ORDINANCE, 1915.

1. A permit to convey or move timber shall be as in the Form in the Schedule to these Rules.

2. Such permits shall be issued by the Wardens of "Proclaimed Districts" and by such persons as the Conservator of Forests may from time to time by writing under his hand authorise to issue them within "Proclaimed Districts."

3. Any Warden of a "Proclaimed District" or other authorised person may refuse to issue such permit until he has been satisfied that the "timber" to be conveyed or removed is *bond fide* private property and has come from "Private Land" with the consent of the owner of such land, or has been brought from Crown Land under a license granted under the Crown Land Forest Produce Rules for the time being in force.

4. Every permit must be returned to the person issuing the same within fifteen days of the date of expiry of such permit or within such further period as the person issuing the same may cause to be endorsed on the said permit and any person acting in contravention of these Rules is liable to a penalty not exceeding £10.

5. Any authorised person may refuse to issue a further permit to any person who fails to return a permit previously issued by him, if such person does not account for his failure to return such permit.

Made by the Governor in Executive Council, this 28th day of March, 1918.

(Sgd.) W. M. GORDON,
Clerk of the Council.

TRINIDAD AND TOBAGO.

No.....

Removal Permit, Forests Ordinance, No. 42 of 1915.

Section 7.

PERMISSION is hereby granted to.....
of.....to remove
from.....
to.....
the following timber.....

Kind of Timber (Species).....

No. and dimensions*.....

Marks.....

Inspected by.....

Date of Issue.....

Date of Expiry.....

Signature of Officer authorised to issue permit.

*Information to be recorded at back if space is not sufficient.

BOTANICAL.

THE WILD ORCHIDS OF TOBAGO.

By W. E. BROADWAY,
Horticulturist & Assistant Botanist.

Little was known of the native orchids of Tobago, until the writer investigated them in co-operation with Mr. G. Humphrey Swarder, a resident planter, during the past few years. Our efforts resulted in fifty-two distinct species and varieties being brought to light. It may be mentioned for purposes of comparison that Trinidad has 154, Grenada 54, St. Vincent 47 and Jamaica 194 different species. Tobago has yielded one new plant, an *Ornithidium*, which Professor Cogniaux commemorated to the writer of this note in the years 1909-1910. The Tobago orchids so far known are as follows:—

1. *BRASSIA LANCEANA* Lindl.—Central parts on forest trees. Flowers greenish-yellow, blotched fragrant, showy. Apparently not as yet found in Trinidad or other West Indian Islands. Tobago, Panama, Columbia, Guiana and Brazil.
2. *BRASSAVOLA CUCULLATA* (L.) R. Br. Flowers white, comparatively large; leaves roundish and fairly long. Grows on small trees above King's Bay, Tobago, Trinidad, Grenada, St. Vincent and the smaller islands near by Dominica, Guadeloupe, Saba, St. Martin, St. Thomas, Mexico, Venezuela.
3. *CAMARIDIUM OCHROLEUCUM* Lindl.—Blossoms of a whitish-yellow colour, lasting but a day or so in their beauty. Frequents partial rotten wood, &c. in the central forests. Tobago, Trinidad, Guadeloupe, Jamaica, Costa-Rica, Venezuela, Guiana and Brazil.
4. *CATASETUM MACROCARPUM* L.O. Rich. (*C. tridentatum*.) Monks-hood.—Low altitudes in particular. The bulbous (pseudo-bulbs) growths in mature specimens are large and prominent. Male and female flowers on separate plants, the round yellowish-green, fragrant flowers of the female attract two native bees. Seed pod large, long and carries a cocoon-like structure (at that time bleached white) until the fruit ripens. Tobago, Trinidad, Venezuela, Guiana and Brazil.
5. *CAMPYLOCENTRUM JAMAICENSE* (Rehb.) Benth.—Found attached to undergrowths (shrubs), Belmont and Adelphi hanging from the branches. Flowers white and tiny. Tobago, Porto Rico and Jamaica.
6. *CAMPYLOCENTRUM PACHYRRHIZUM* (Rehb. f.) Rolfe.—A leafless orchid producing short strings of white flowers. Grows with No. 5, long greyish coloured, flattened roots. Tobago, Trinidad, Jamaica and Cuba.

7. *CORYANTHES SPECIOSA* Hook.—Bat orchid. Flower-stems at first upright, hanging ultimately in the specimens of it observed. Mr. Sworder found this always accompanied by black, stinging ants which occupied the ball of roots. Flowers yellow or richly spotted with reddish-brown blotches, very fragrant. In the forests on trees. Tobago, Trinidad, Guatemala, British Guiana and Brazil.
8. *CRANICHIS MUSCOSA* Sw.—A small ground orchid met in one place only near the Widow. Flowers greenish-white. Tobago Trinidad, Grenada, St. Vincent, Martinique, Dominica, Porto Rico, Jamaica, Cuba, Florida and Venezuela.
9. *DICHÆA MURICATA* Lindl.—A small plant bearing whitish flowers. In forest parts on trees. Tobago, Grenada, St. Vincent, Martinique, Dominica, Guadeloupe, Porto Rico, and Cuba, Margarita and Juan Griego.
10. *DIACRIUM BICORNUTUM* Benth.—The Virgin. Flowers borne on long stalks, white with markings on the lip. Lasts weeks at a time in bloom. Grows upon rocks and trees in the full blast of wind and sea-spray close to beaches and cliffs. Tobago, Trinidad and British Guiana.
11. *EPIDENDRUM ANCEPS* Jacq.—Found at the Widow on trees and shrubs. Tobago, Grenada, Barbados, St. Vincent, St. Lucia, Martinique, Dominica, Guadeloupe, Antigua, St. Kitts, Saba, Porto Rico, St. Domingo, Haiti, Jamaica, Cuba, Margarita, Tropical America.
12. *EPIDENDRUM BRADFORDII* Griseb.—On trees at Menna central forest parts, apparently scarce. Tobago and Trinidad.
13. *EPIDENDRUM DISCOLOR* (Lindl.) Benth.—Occasionally met growing upon trees in forest lands. Tobago, Trinidad, Guatemala Surinam and Brazil.
14. *EPIDENDRUM* sp.—A small plant on trees in the forests near Caledonia. Flowers seldom if ever open. Not yet determined.
15. *EPIDENDRUM FRAGRANS* Sw.—Vanilla orchid. Clumps of this fix themselves to boulders and trees. Flowers on short stems, white and lilac, fragrant. Usually found inland. Tobago, Trinidad, Grenada, St. Vincent, Dominica, Jamaica, Cuba, Tropical America.
16. *EPIDENDRUM FULGENS* Brongn.—Forest lands on trees where it develops in good sized clumps. Flowers on long stalks, purplish. Tobago, Trinidad, British Guiana and Brazil.
17. *EPIDENDRUM GLOBOSUM* Jacq.—A little, grassy looking plant bearing white flowers. On shrubs and trees at Adelphi, Belmont, Menna, etc. Tobago, Trinidad, Grenada, St. Vincent, Martinique, Dominica, Guadeloupe, St. Kitts, St. Eustache, Saba, Porto Rico, Jamaica, Cuba, Margarita, Tropical America.

18. *EPIDENDRUM HARTII* Rolfe.—A graceful plant whether in or out of blossom. On a tree at Mount Dillon. Flowers primrose scented, white tinged green. Leaves shiny green. Stems leafy marked with reddish coloured lines. Tobago and Trinidad.
19. *EPIDENDRUM NOCTURNUM* Jacq.—The larger form with white flowers is found on trees in the cooler forest districts, as well as a smaller flowered, narrow leaved one doubtfully referred at present to *E. nocturnum*. Tobago, Trinidad, Grenada, St. Vincent, St. Lucia, Martinique, Dominica, Guadeloupe, Porto Rico, St. Domingo, Haiti, Jamaica, Cuba, Bahama, Cuba, Guadeloupe, Maragarita, Surinam.
20. *EPIDENDRUM RAMOSUM* Jacq.—On trees in forests, The Widow. Tobago, Grenada, St. Vincent, St. Lucia, Martinique, Dominica, Guadeloupe, Porto Rico, Haiti, Jamaica, Cuba, Tropical America.
21. *EPIDENDRUM RIGIDUM* Jacq.—Flowers yellowish green coloured. On exposed trees, Adelphi and Belmont, Tobago, Trinidad, Grenada, St. Vincent, Martinique, Guadeloupe, Porto Rico, St. Domingo, Haiti, Jamaica, Cuba, Margarita, Florida, Tropical America.
22. *EPIDENDRUM SCHOMBURGHII* Lindl. var. *SWORDERII*.—Flowers yellow. On trees in clumps. Recommended for inclusion in cultivated collections. Tobago.
23. *EPIDENDRUM STENOPETALUM* Hook.—On trees in exposed places at Adelphi and Belmont, etc. Flowers rose coloured. Tobago, Trinidad, Jamaica, Mexico, Central America, Columbia, Venezuela, Guiana, Brazil.
24. *EPIDENDRUM STROBILIFERUM* Rehb. f.—Grows with numbers 21 and 23. Tobago, Trinidad, Grenada. St. Vincent, Martinique, St. Domingo, Jamaica, Cuba, Venezuela, Guiana, Brazil.
25. *GONGORA ATROPURPUREA* Hook.—Forest woods attached to trees, scarce. Flowers on hanging stalks, claret coloured.
26. *HABENARIA MACULOSA* Lindl.—Terrestrial. On banks at Adelphi where in the early months of the year the whitish flowers show out prominently among the grasses, etc.
27. *HABENARIA MONORRHIZA* (Sw.) Cogn.—Banks at Adelphi and abundant in grass lands, Highmoor, near Scarborough. Flowers green.
28. *HEXISIA REFLEXA* Rehb. f.—Clumps of this hang from trees and look like grass leaves. Central parts of the island. Tobago, Trinidad, Grenada, Surinam, Brazil.
29. *IONOPSIS UTRICULARIODES* (Sw.) Lindl.—On a calabash tree *Crescentia Cujete*, Providence, in sunlight. Grows in quantities together. Flowers pale purple or lavender colour on branched, upright stems in the bigger plants. Rare. Tobago, Trinidad, St. Vincent, Martinique, St. Thomas, Porto Rico, St. Domingo, Jamaica, Cuba, Florida, Tropical America.

30. *IONOPSIS TERES* Lindl.—Central parts of the island on trees. Flowers pale lavender colour. The adult plants much smaller than those of No. 29. Tobago, Trinidad, Porto Rico, St. Domingo, Jamaica, Cuba, British Guiana, Surinam.
31. *LEOCHILUS LABIATUS* (Sw.) O. Kuntze.—Found upon small trees at Adelphi. A conspicuous little plant in flower. Tobago, Trinidad, St. Vincent, Dominica, Guadeloupe, Porto Rico, Haiti, Cuba.
32. *LIPARIS* sp.—Collected a single plant on a bank near Mason Hall. In fruit but material inadequate for exact determination. Tobago and probably other places.
33. *MICROSTYLIS UMBELLIFLORA* (Sw.) Hitchc.—A ground orchid. Forest Reserve above Caledonia, etc. Flowers green in colour. Tobago, Trinidad, St. Vincent, Dominica, Guadeloupe, St. Kitts, Haiti, Jamaica, Cuba, Mexico.
34. *MAXILLARIA* sp.—A single unflowered specimen met in forest parts near Menna.
35. *OCTOMERIA GRAMINIFOLIA* (L.) R. Br.—Forest Reserve above Caledonia on trees. A small species with a running habit upon the bark of trees. Tobago, Grenada, St. Vincent, Martinique, Dominica, Guadeloupe.
36. *ONCIDIUM GUTTATUM* (L.) Rehb. f. (*O. luridum* Lindl.)—King Peter's Bay on small trees along the sea shore. It seems a strange fact to state that this is the only *Oncidium* so far found in the island; not even *O. papilio* (Butterfly orchid) having been found. Tobago, Trinidad, Grenada, St. Vincent, St. Lucia, Martinique, Dominica, Jamaica, Cuba, Margarita, Florida, Mexico, Guatemala, Columbia, Venezuela, Peru.
37. *ORNITHIDIUM BROADWAYI* Cogn.—A new species. Plant small. Road between Belmont and Adelphi on an *Erythroxylon*, intermixed with other small growing orchids. Tobago only.
38. *ORNITHIDIUM CONFERTUM* Griseb.—Found with No. 37. and in one or two other places. Tobago, Trinidad, Grenada, Porto Rico, Cuba.
39. *ORNITHOCEPHALUS GLADIATUS* Hook.—A small, fan-shaped orchid. For the size it flowers profusely. On calabash, Les Coteaux; and Adelphi, etc., on under shrubs. Tobago, Trinidad and Grenada.
40. *PLEUROTHALLIS SERTULARIOIDES* Spreng. var. *trinitensis* Griseb.—Plant small, running along branches of shrubs, &c. In forest lands. Tobago and Trinidad.
41. *PHYSURUS PLANTAGINEUS* (L.) Lindl.—Grows in the ground under forest trees, Menna, &c. Flowers white. Tobago, Trinidad, Grenada, St. Vincent, Martinique, Dominica, Guadeloupe, Saba, Porto Rico, Haiti, Jamaica, Cuba.

42. *POGONIA* sp.—Trafalgar in the ground. So far only two small plants have been found and these were met by Mr. J. Humphrey Swarder. At present it is doubtful as to which *Pogonia* it can be referred.
43. *POLYSTACHYA LUTEOLA* (Sw.) Hook.—On a tree, Pigeon Hill, Charlotte Ville. Flowers pale yellow. Seems scarce. Tobago, Trinidad, Grenada, St. Vincent, St. Lucia, Martinique, Dominica, Guadeloupe, St. Kitts, St. Thomas, Porto Rico, St. Domingo, Jamaica, Cuba, Bahama, Florida, Tropical America.
44. *PRESCOTTIA STACHYOIDES* (Sw.) Lindl.—A ground or terrestrial orchid in forest parts. Infrequently met. Tobago, Grenada, St. Vincent, Martinique, Dominica, St. Eustache, Guadeloupe, Porto Rico, Jamaica, Cuba, Central America, Brazil.
45. *SCAPHYLOTTIS PROLIFERA* (R. Br.) Cogn.—Likes to locate itself upon the big trunks of trees in forests. Species small. Flowers white. Tobago, Trinidad, Grenada, Guiana, Brazil.
46. *SPIRANTHES ACAULIS* (Smith) Cogn.—Found in the ground on banks, etc. under trees among rotten leaves. Foliage variegated, ornamental. Flowers greenish-white, odour strong and somewhat unpleasant. Plentiful in the districts where it grows. Tobago, Trinidad, Grenada, Tropical America.
47. *STELIS OPHIOGLOSSOIDES* (Jacq.) Sw.—Flowers yellow. Plants small, tufted. On trees in forests. Tobago, Trinidad, Grenada, Martinique, Haiti, Guadeloupe, St. Kitts, Jamaica, Cuba, Mexico, Costa Rica, Ecuador, Guiana.
48. *STENORRHYNCHOS ORCHIOIDES* (Sw.) L. C. Rich.—Terrestrial in dry, hard, exposed places near public roads, etc. Flowers reddish-yellow, usually. Blossoms in the early months of the year (dry season) before the leaves appear. Tobago, Trinidad, Grenada, Barbados, St. Vincent, St. Lucia, Martinique, Dominica, Guadeloupe, Antigua, St. Thomas, Porto Rico, St. Domingo, Jamaica, Cuba, Bahamas, Tropical America.
49. *TETRAGAMESTUS MODESTUS* Rehb. f. Establishes itself on forest trees, &c. Tobago, Trinidad, Grenada, Martinique, Porto Rico, Haiti, Brazil.
50. *VANILLA HARTII* Rolfe.—Lot 42 near Easterfield. Flowers white tinted green, slightly odoriferous but unpleasantly so. Tips of the leaves curl downwards. Climbs up small trees. Tobago and Trinidad.

51. *VANILLA INODORA* Schiede.—The Widow near Caledonia, Menna, &c. A conspicuous plant when seen upon tree trunks with stems 30 or more feet long. Leaves large, broad and not fleshy. Tobago, Trinidad, Grenada, Martinique, Dominica, Guadeloupe, Porto Rico, St. Domingo, Jamaica, Cuba, Mexico, Guiana.
52. *VANILLA PHAENANTHA*. Rchb. f.—Lot 42 near Easterfield. A large climber. Leaves stiff, fleshy. Flowers greenish coloured. Tobago, Trinidad, St. Vincent, Cuba, Bahamas.

THE PALMS OF SEYCHELLES, MAURITIUS, ETC.

UNDER the title "The Palms of the Seychelles and the Mascarenes" Dr. W. Botting Hemsley, F.R.S., formerly Keeper of the Herbarium of the Royal Botanic Gardens Kew, published in *Nature* Vol. 101 No. 2526, an article on the fifteen palms which are native to the Seychelles, Mauritius, Rodriguez and Bourbon. These palms several of which are of very handsome appearance are found nowhere else in the world than in this group of islands and, as shown in the table below, no less than eight occur in one island or group of islands only. For example the six Seychelles species are endemic i.e. confined to the Seychelles, whilst similarly two of the three Rodriguez species occur nowhere else in the world.

The paper is of special interest in Trinidad inasmuch as the Royal Botanic Gardens and St. Clair Experiment Station contain no less than ten out of these fifteen palms, all of which thrive here and seed, excepting *Lodoicea* the Coco-de-Mer and *Latania Verschaffeltii* (L. aurea) which have not reached maturity, and *Acanthophoenix nobilis* (*Deckenia nobilis*) only recently introduced. See "The Cultivated Palms of Trinidad," *Bulletin* XVI, 1917 226-44). The species in Trinidad are indicated by an asterisk in the table below.

"Since the publication, just forty years ago, of Dr. I. B. Balfour's elaboration of the palms in J. G. Baker's *Flora of Mauritius and Seychelles*, there has been considerable botanical activity in the islands of the Indian Ocean. Cordermoy's *Flora de l'Île de la Reunion* appeared in 1895, and many novelties have been discovered, especially in Mahé, and published; but no addition has been made to the number of genera and species of palms inhabiting this insular region. Nevertheless, a number of interesting facts have come to light, partly through Prof. Stanley Gardiner's published notes, partly through various collectors' notes, and especially through Mr. P. R. Dupont's direct communications. Mr. Dupont, it should be explained, has been for many years curator of the Botanic Station at Mahé, and has thoroughly

explored that island and more or less the rest of the Seychelles group, famous for its peculiar palms. The following table shows the composition and distribution of all the palms of the islands of the western Indian Ocean, excluding those of Madagascar:—

Distribution of the palms of Seychelles and the Mascarenes—Genera and Species.				Seychelles.	Rodriguez.	Bourbon.	Mauritius.
* <i>Lodoicea sechellarum</i>	...	...	...	x	—	—	—
* <i>Latania commersonii</i>	...	...	...	—	—	x	x
* <i>L. loddigesii</i>	...	...	...	—	—	—	x
* <i>L. verschaffeltii</i>	...	...	...	—	x	—	—
<i>Hyophorbe indica</i>	...	...	...	—	—	x	x
* <i>H. amaricanalis</i>	...	...	...	—	—	—	x
* <i>H. verschaffeltii</i>	...	...	...	—	x	—	—
* <i>Dictyosperma alba</i>	...	...	...	—	x	x	x
<i>Acanthophoenix rubra</i>	...	...	...	—	—	x	x
A. <i>crinita</i>	...	...	...	—	—	x	x
* A. <i>nobilis</i>	...	...	...	x	—	—	—
<i>Nephrosperma vanhouttei</i>	...	...	...	x	—	—	—
<i>Roseheria melanocheates</i>	...	...	...	x	—	—	—
* <i>Verschaffeltia splendida</i>	...	...	...	x	—	—	—
* <i>Stevensonia grandifolia</i>	...	...	...	x	—	—	—
				6	3	5	7

"With possible exceptions in Madagascar, the genera named in this table are restricted in their natural distribution to the islands and groups of islands named, and the Seychelles species and two out of three of the Rodriguez species are endemic, while the five Bourbon species are common to that island and Mauritius. *Lodoicea* and *Latania* are dioecious, and belong to the tribe Borasseae, which is restricted to the African region in a broad sense, and comprises only two other genera, namely, *Borassus* (the palmyra), and *Hyphaene*, to which the characteristic branching palms of Africa belong. The rest of the genera in the table are all referred to the large, and generally dispersed, tribe Areceae. Palms constitute the most striking feature in the vegetation of Seychelles, especially of the principal island, Mahé, where five out of the six species were formerly more or less abundant, and still persist in plenty. *Lodoicea*, the coco-de-mer, or double coconut, does not occur in the wild state in Mahé.

"Travellers have differed in opinion as to in which of the Islands it is really indigenous, but trustworthy evidence points to Praslin, Curieuse, and Round Islands. A statement to this effect, by J. Harrison, appears in the *Botanical Magazine* for 1827, in the text to plates 2784-88. There is the further statement that this palm was "growing in thousands close to each other, and the sexes intermingled." Mr. Dupont communicates independent testimony to the existence of local evidence confirming this record. In favourable situations the double coconut attains a height of 100 ft., or occasionally even more.

"Little is on record of the general distribution in the islands of the palms of Seychelles; but Dupont furnishes the following particulars of their altitudinal distribution in Mahé:—

Nephrosperma	0-300 m. (1)	Acanthophoenix	0-750 m.
Stevensonia	150-600 "	Verschaffeltia	150-750 "
Roscheria	600-900 "		

"He also distinguishes three zones of the predominating palms in Mahé:—

Zone of <i>Stevensonia grandifolia</i>	... 150-300 m.
Zone of <i>Verschaffeltia splendida</i>	... 300-600 "
Zone of <i>Roscheria melanochaetes</i>	... 600-900 "

"These palms constitute a striking feature in the vegetation of Seychelles, especially that of Mahé, where they are associated with other singular endemic types belonging to various families. In stature and foliage they conspicuously overtop most of the other trees, with an average height of the five species of 45 to 65 ft., and extreme heights of *Acanthophoenix nobilis* of 80 to 120 ft., and of the magnificent *Verschaffeltia splendida* of 80 ft. All these palms are, or have been, in cultivation in the United Kingdom, but are rarely seen on account of their large dimensions and heat requirements. But characteristic paintings of all these palms are to be seen in the Seychelles section of the North gallery at Kew, together with many other of the endemic types of the archipelago. It may be worth mentioning here that some confusion has arisen in consequence of the local misuse of the terms male and female of the double coconut. This palm is really dioecious, and the large fruit is usually either two- or three-lobed, the two-lobed being named female and the three-lobed male! The presence of so many endemic palms in a small insular flora is almost unique in the geographical distribution of plants. Lord Howe Island, situated about 300 miles off the coast of New South Wales, presents the nearest approach to a parallel, supporting, as it does, four endemic palms, belonging to three different genera, two of which are peculiar to the Island. The profusion and elegance of these palms excite the admiration of all who see them. Of the Howe palms, *Kentia belmoreana* is one of the very best for dwelling-room decoration, the writer having kept a plant in excellent condition for twenty-six years.

"In connection with the insular distribution of palms, it may be added that New Zealand, the Kermadec Islands, Norfolk Island, Juan Fernandez, and Bermuda each possesses one species of palm, which seems to indicate a very ancient vegetation. The coconut is left out of consideration here, because Mr. O. F. Cook seems to have proved beyond doubt that it is of American origin, and that it owes its present distribution almost entirely to human agency."

(1) 1 m. or 1 metre is 3·281 ft. 100 m. = 328 ft.—(Ed.)

The cultivated Palms of Trinidad.—Two other species can now be added to the eighty-nine already recorded in this *Bulletin* XVI. 1917, 226-44 as being in the collection of the Royal Botanic Gardens and St. Clair Experiment Station.

LATANIA COMMERSONII, Gmel. Mauritius and Bourbon.

This palm is very similar in general appearance to *Latania Loddigesii* and not readily recognizable from that species. They can however be easily distinguished by the different shape and marking of their seeds which in this species are about $1\frac{1}{2}$ inches long and 1 inch broad with longitudinal markings on every side, whilst in *L. Loddigesii* they are about ($2\frac{1}{4}$ inches in length and $\frac{3}{4}$ inch broad) with longitudinal striated markings on the rounded side only.

Both species seed freely.

LATANIA AUREA, Duncan. Rodriguez.

A small plant of this species is growing near the Rockery. Bailey in his *Cyclopædia of Horticulture* describes it as follows:—

L. Verschaffeltii, Lem. (*L. aurea*, Duncan) "Wild specimens 40 ft.; about half this in cultivation: leaves pale green, $4\frac{1}{2}$ to 5 ft. long, the segments $2\frac{1}{2}$ ft. long, above 2 in. wide, acuminate, the entire margins and veins slightly tomentose beneath petioles 5-8 ft., densely tomentose, with entire, orange margins, spiny in young plants, spadix 4-8 ft. long: droop slightly 8-angled, 2 in. long, $1\frac{1}{2}$ in. wide."

R.O.W.

CHEMICAL.

THE FRUITS OF THE MORICHE PALM.

Mauritia setigera.

The Moriche Palm, *Mauritia setigera*, is abundant in certain localities in Trinidad, *e.g.*, at the Aripo Savannah, on the edge of the Pitch Lake, etc. On the Aripo Savannah the Moriche forms large groups, or islands, standing out conspicuously on the grass land. Such a place is often called a Morichal, just as a Cocal is a place of coconut palms, *e.g.*, the Nariva Cocal.

The Moriche is one of the tallest palms of the Colony reaching about 100 feet in height. It bears huge bunches of fruits weighing about 100 lb. The separate fruits are reddish brown, nearly spherical, and covered on the outside by hard overlapping scales. The average weight of a single fruit is approximately 2 oz. The proportion of kernel to "shell" or pericarp is 47·5 per cent. On air drying the kernel loses about 50 per cent. of its weight and the shell 68 per cent.

The following is the result of analysis by Mr. A. E. Collens, F.C.S., of air-dry shell and kernels :—

			<i>Shell.</i>	<i>Kernels.</i>
Water	...	...	6·96	13·16
Albuminoids	...	...	3·81	4·57
Ether extract	...	...	1·74	·51
Digestible cellulose, etc.		...	55·91	24·35
Woody Fibre	...	...	28·18	53·45
Ash	...	...	3·40	3·96
			<hr/> 100·00	<hr/> 100·00

The fresh kernels had a granular, somewhat glistening fracture, apparently oily, but found to be due to water. The dried kernels were extremely hard and horny; they had lost all crystalline appearance on fracture and resembled dull white ivory. They appeared eminently suitable for making artificial buttons, which however are extremely liable to weevil attacks in tropical climates.

FORMATION OF FAT IN THE BARK OF WEST AFRICAN MAHOGANY.

Khaya senegalensis.

By A. E. COLLENS, F.I.C., F.C.S.

In the St. Clair Experiment Station are a few trees of the West African Mahogany (*Khaya senegalensis*). They are subject to a peculiar scaling of the bark. Mr. J. Jones, Curator of the Botanic Station, Dominica, reports that trees in that island are similarly affected.

In 1911, several trees at St. Clair of this species of Mahogany were noticed to be suffering from some bark disease, and wherever attacked the bark was noticed to be scaling off in warty squamose pieces which were greasy to the touch, had a strong fatty acid odour and ignited readily when kindled, burning with a steady smoky flame. (1)

Pieces of the bark were examined with the following results:—

	Upper portion 6" above diseased patch.	Diseased portion.	Lower portion 6" below diseased patch.
Water	40.81	4.94	58.83
* Organic Matter	57.84	98.80	44.47
Ash	1.85	1.76	1.90
	100.00	100.00	100.00

	Under	Under
* Containing Solid Fat	0.5 per cent.	64.4 per cent. 0.5 per cent.

The fat was solid, yellow and crystalline with an acid smell suggestive of rancid tallow. It readily saponified with dilute potash. This is an unusual instance of fat being deposited in a vegetable body in the case of wound irritation, and so far no references have been found in connection with such a phenomenon and especially so in connection with *Khaya senegalensis*. (2)

A similar scaling eruption of the bark of *Khaya senegalensis* having since been reported from Dominica, further investigation was conducted with the expressed fat.

A sample of the fat was obtained by means of a small screw press from some freshly gathered diseased bark, 29 per cent. being extracted by this method as compared with 64 p.c. by solvents.

(1.) The characteristic scaling effect is well illustrated in a plate of a tree in the Experiment Station, Trinidad, (Trunk of the African Mahogany tree) published in the *Bulletin of the Pan American Union*, 1916, 73.

(2.) A preliminary examination of the bark of *Khaya senegalensis* from the Northern Provinces, Nigeria is given in the *Bulletin Imperial Institute*, 1915, 49, but no mention of the presence of solid fats is made. The occurrence of resinous constituents is negatived.

The results of the examination of the fat were as follows:—

Specific gravity at	$\frac{100\text{ }^{\circ}\text{C.}}{15\cdot5\text{ }^{\circ}\text{C.}}$	...	0.866
Volatile at 100 °C. per cent.	...	...	0.29
Ash per cent.	...	...	0.12
Butyro refractometer Index @ 50 °C.	...	...	89.5
Acid value	...	...	180.
Saponification value	...	...	206.
Titer test	...	...	45.6 °C.
Iodine value per cent.	...	...	42.00
Fehner value	...	...	95.47
Insoluble fatty acids per cent.	...	...	94.51
Volatile fatty acids—Soluble per cent.	...	...	3.2
" " " Insoluble "	...	...	0.7
Mixed fatty acids—neutralisation No.			
	(Saturation No.)		186.
" " molecular weight	...		801.7

The fatty acid content of the fat (equivalent to 82.83 per cent. expressed as Palmitic acid or 91.45 as Stearic acid) is high. It may possibly be due to the bark having been exposed (on the tree) to atmospheric conditions for a prolonged period. The other analytical data indicate that the fat is akin in character to solid fats of a similar nature such as Rambutan tallow (*Nephelium lappaceum*) Chinese vegetable tallow (*Stillingia sebifera*), Mkanji butter (*Stearodendron stuhlmanni*) etc.

The fat saponified readily with a cold 30 per cent. solution of caustic soda (1.8 density). It gave no colour re-action with Halphen re-agent.

METEOROLOGY.

RAINFALL RETURN APRIL TO JUNE, 1918.

Stations.	April.	May.	June.	January to June, 1918.	January to June, 1917.
<i>North-west District.</i>	Ins.	Ins.	Ins.	Ins.	Ins.
St. Clair—Royal Botanic Gardens ...	1.27	2.94	5.87	10.08	16.65
Port-of-Spain—Colonial Hospital ...	.52	1.71	4.79	12.14	12.18
„ Royal Gaol... ..	.91	1.79	4.57	17.12	13.14
„ Constabulary Headquarters ...	.79	1.21	4.40	12.17	14.06
St. Ann's—Reservoir ...	1.04	2.53	6.74	21.08	20.68
Maraval— „ ...	.95	2.13	6.73	18.24	17.33
„ Constabulary Station ...	1.12	4.07	6.83	19.04	19.52
Diego Martin—Constabulary Station ...	1.19	7.65	8.99	26.46	21.00
„ Waterworks ...	.84	6.13	7.16	20.55	18.20
„ River estate ...	.87	6.38	6.94	20.99	17.33
Fort George Signal Station ...	.73	2.67	7.19	15.75	13.53
North Post „ ...	1.10	7.24	3.49	18.90	13.89
Carenage Constabulary Station ...	1.10	2.85	6.74	20.21	20.69
Carrera Island Convict Depôt ...	.58	.82	2.01	5.97	7.14
Chacachacare Lighthouse ...	.91	3.35	8.16	19.52	15.24
<i>Santa Cruz—Maracas District.</i>					
Santa Cruz—Constabulary Station ...	1.75	3.38	7.24	21.63	20.16
St. Joseph—Government Farm ...	.87	2.28	6.72	15.40	16.42
„ Constabulary Station ...	.35	2.57	4.84	10.97	13.69
Tunapuna—St. Augustine estate ...	.92	3.35	6.31	14.75	13.60
Maracas—Government School ...	1.10	3.00	7.07	22.46	20.49
„ Ortinola estate ...	1.68	3.30	7.06	19.82	18.87
„ San José estate ...	.80	2.78	8.44	18.83	..
Caura—Wardour estate ...	1.17	2.92	8.54	18.68	18.15
<i>West Central District.</i>					
Caroni—Frederick estate ...	1.13	5.17	8.71	20.35	13.05
Chaguanas—Constabulary Station ...	.67	3.38	5.90	15.61	14.14
„ Woodford Lodge estate ...	1.55	3.20	5.36	15.77	13.03
Carapichaima—Waterloo estate ...	1.29	6.29	6.39	20.47	15.96
„ McBean Cacao estate ...	1.82	3.84	6.26	17.27	13.20
„ Friendship Hall estate... ..	1.20	no record	no record	15.55	..
Couva—Exchange estate ...	.66	3.06	4.17	11.75	12.08
„ Brechin Castle estate ...	1.08	4.58	6.23	17.41	13.95
„ Perseverance „ ...	.69	2.78	4.33	12.40	13.26
„ Camden „ ...	.29	3.88	4.13	..	11.05
„ Milton „ ...	.62	3.96	6.67	17.98	14.76
„ Spring „ ...	2.44	5.60	6.44	23.11	18.92
„ Constabulary Station ...	.70	2.84	5.13	13.55	16.10
„ Esperanza estate ...	.76	5.00	5.19	15.80	13.54
<i>Montserrat District.</i>					
Brasso-Piedra—Mamoral estate ...	2.68	8.05	9.01	33.05	22.79
„ La Mariana estate ...	2.54	6.29	9.51	29.63	22.89
Montserrat Constabulary Station ...	.78	4.57	7.71	21.40	15.31
Brasso—La Vega estate ...	2.02	5.97	10.39	29.40	23.66
<i>Arima District.</i>					
Arima—Warden's Office ...	1.88	6.23	10.05	24.55	..
„ Torrecilla estate ...	2.09	6.23	11.27	29.55	24.22
„ Verdant Vale estate ...	2.99	6.15	10.37	27.21	22.31
San Rafael—Constabulary Station ...	1.76	6.30	11.41	33.21	24.56
Guanapo—Talparo estate ...	2.49	8.32	10.39	31.25	24.70
„ San José Estate ...	3.13	8.28	11.47	36.23	25.38
Tamana—Sta. Marta estate ...	3.57	9.10	14.27	43.32	30.40
„ La Corona estate ...	3.42	8.23	11.63	37.61	30.40
<i>San Fernando & Princes Town District.</i>					
Claxton's Bay—Forres Park estate ...	1.41	3.51	6.22	18.07	13.07
Pointe-à-Pierre—Bonne Aventure est. ...	1.39	6.30	7.64	21.48	13.49
„ Concord estate ..	1.37	6.71	8.21	28.33	16.42
„ Plein Palais estate ..	1.49	4.52	6.45	18.53	16.98
Napierima—Picton estate ...	1.86	3.80	7.46	23.11	16.80
„ Usine St. Madeleine ...	.94	3.31	7.72	23.55	14.24
„ La Fortunée estate ...	.82	3.99	6.52	18.40	14.75
„ Tarouba estate ...	.49	2.07	..	..	10.34
„ Union Hall estate ...	1.45	3.62	7.01	21.96	15.96

RAINFALL RETURN—APRIL TO JUNE, 1918.—CONTINUED.

Stations.	April.	May.	June.	January to June, 1918.	January to June, 1917.
<i>San Fernando and Princes Town District.—(Contd.)</i>					
Naparima—Palmiste estate	1.73	4.48	8.63	23.73	21.30
„ Lewisville House	1.63	2.81	7.62	21.90	17.06
„ Hermitage estate	1.16	4.72	7.38	21.67	14.49
„ Petit Morne estate ... ..	.76	2.50	6.99	17.80	10.97
Princes Town—Craignish estate	1.46	4.20	7.71	24.76	11.04
„ Cedar Hill estate ... ..	.41	3.86	...	...	14.04
„ Williamsville estate	1.90	5.42	7.20	21.54	14.01
„ Esmeralda estate	1.02	6.51	8.66	24.74	18.99
„ New Grant estate	2.55	8.50	9.68	34.78	17.08
„ Constabulary Station ... ..	.44	4.05	6.02	20.44	11.84
„ Hindustan estate	1.88	5.67	8.07	25.87	14.26
„ La Retraite estate	3.50	8.67	12.43	40.13	26.00
„ Malgretoute estate	1.58	3.55	...	...	14.58
„ Friendship & Ben Lomond estates	1.42	3.76	...	...	15.32
„ Los Naranjos estate	1.31	3.68	9.72	25.64	15.35
Poole—El Rosario estate	3.91	7.84	8.26	35.24	24.23
<i>South-west District.</i>					
Oropuche—Constabulary Station	1.20	4.45	10.27	25.69	17.55
„ Pluck estate ... ..	.75	4.50	9.41	24.19	12.12
Siparia—Constabulary Station ... ..	.83	7.42	9.79	27.98	17.76
„ Alta Gracia estate	1.00	7.14	10.89	29.14	17.59
Guspo—Adventure estate ... ..	.73	5.23	9.48	22.78	19.14
Point Fortin—Constabulary Station ... ..	.98	5.77	9.15	24.43	23.37
Erin—La Ressource estate	Nil	3.00	8.84	22.86	21.48
La Union estate	1.08	5.16	8.05	24.06	22.54
Industry estate	1.43	5.65	7.55	25.00	21.00
Cedros—La Retraite estate	1.17	2.95	9.77	28.12	24.62
„ Beaulieu estate	1.01	.83	5.83	19.71	19.84
„ Perseverance estate ... ..	...	...	...	...	19.11
„ St. Marie estate	1.55	1.82	8.22	24.69	20.05
„ Constabulary Station ... ..	.92	.99	7.57	22.77	20.07
„ St. Quintin estate	1.21	1.53	5.89	23.91	17.35
Loacos—Constance estate	2.10	2.83	15.97	56.38	26.40
Irois—Government School	1.44	2.99	8.59	24.46	30.67
<i>South Coast.</i>					
Moruga—Constabulary Station	1.64	5.10	7.26	23.96	18.65
<i>East Coast.</i>					
Matura—La Juanita estate	3.41	8.33	12.57	41.03	27.84
Manzanilla—Constabulary Station	2.80	9.17	11.11	38.61	25.90
„ Indrasan estate	3.56	8.04	10.34	37.44	...
Sangre Grande—New Lands estate	5.68	9.27	10.24	39.62	30.45
„ Evasdale estate	3.34	9.16	10.17	38.37	25.88
„ Grosvenor estate	3.00	8.36	9.85	30.72	30.33
„ San Hilario estate	2.03	7.08	9.00	30.59	24.59
„ San Francisco estate	4.34	8.44	11.67	11.67	...
Mayaro—Constabulary Station	2.80	5.96	11.71	36.60	22.54
<i>North Coast.</i>					
Blanchisseuse—Constabulary Station	3.84	3.85	9.53	39.24	26.21
Grande Rivière—Mon Plaisir estate	5.74	6.73	...	...	30.66
Toco—Aragua House	4.37	4.23	9.55	35.34	19.72
„ Constabulary Station	3.69	4.21	7.11	31.20	21.14
Point Galera—Light House	2.77	3.65	6.83	26.81	15.88
<i>Tobago.</i>					
Tobago—Hermitage estate	1.92	13.56	6.59	34.51	22.53
„ King's Bay „	1.45	8.08	7.65	31.87	25.67
„ Roxburgh „	2.00	10.08	...	...	26.55
„ Lure estate	1.85	9.08	6.07	31.21	20.41
„ Botanic Station	1.01	7.84	10.39	26.06	17.75
„ Government Farm ... ..	.61	6.35	7.38	19.00	11.52
„ Lowlands estate ... ..	.30	5.45	5.88	21.82	16.11
„ Friendship „29	6.90	7.78	22.70	11.39
„ Riversdale „82	5.49	6.01	22.19	20.06
„ Bon Accord „96	5.12	5.34	17.95	12.17

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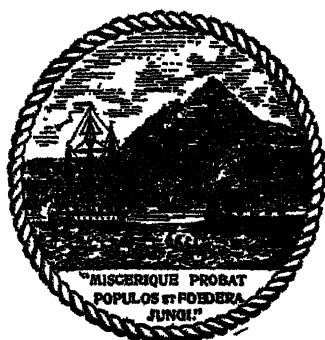
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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE, TRINIDAD & TOBAGO.

Issued by the Department and Board of Agriculture.



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under Ordinance No. 30, 1915.

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Froghopper Investigations.

Special Appointment.

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Reference Library.

THIS Library can be consulted at the Head Office of the Department, St. Clair Experiment Station. It contains standard works on General Agriculture, Horticulture, Botany, etc., and books and periodicals dealing with Cacao, Sugar, Coconuts, Rubber, Cotton, Tobacco, and other crops.

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Department of Agriculture.

GOVERNMENT STUD ANIMALS.

THE following are the arrangements for November and December with regard to Stud animals of the Government Farms in Trinidad and Tobago.

Stallions.

<i>Name.</i>	<i>Class.</i>	<i>Where standing for Service.</i>	<i>Fee.</i>	<i>Groom's Fee.</i>
QUICKMATCH.	Thorough-bred	...Govt. Farm Trinidad...	\$ 10.00	60c.
SIR HOBRY...	Thor'gh-bred Hackney.	Govt. Farm ,, ...	5.00	60c.
SIR HORACE..	Half-bred Hackney	Govt. Farm ,, ...	5.00	60c.
RILLINGTON	SPARTAN..	Cleveland Bay..Govt. Farm ...	5.00	60c.
MARAT	...Thorough-bred	...Govt. Farm Tobago ...	4.80	60c.

Jack Donkeys.

Monarch	...American Donkey	...Govt. Farm	... \$ 5.00	60c.
President	... Do. do.	...Govt. Farm, Tobago...	5.00	60c.

Bulls.

A.—AT GOVERNMENT FARMS.

TRINIDAD.

TOBAGO.

<i>Class.</i>	<i>Fee.</i>	<i>Class.</i>	<i>Fee.</i>
2 pure-bred Zebu	... \$ 1.20c.	1 Half-bred Holstein	...\$1.00
1 " Jersey	... 2.40c.	1 Pure-bred Zebu	... 1.00
2 half-bred Red Poll	... 1.20c.	1 Pure-bred Shorthorn	... 2.40

B.—AT PUBLIC PASTURES.

<i>Place.</i>	<i>Class.</i>
Queen's Park Savannah	2 Half-bred Shorthorn; 1 Half-bred Guernsey.
Mucurapo Pasture:	1 Pure-bred Shorthorn; 1 Half-bred Holstein.
St. Augustine Estate:	1 Half-bred Holstein; ½ Bred Shorthorn; ½ Bred Guernsey.
River Estate:	1 Half-bred Zebu;
San Fernando:	1 Pure-bred Holstein; ½ Bred Jersey.
Arima:	1 Half-bred Jersey.

Pigs.

AT GOVERNMENT FARM, TRINIDAD.

White Yorkshire, Berkshire, Tamworth	... Fee \$1.00;
Attendant's Fee	25c.

AT GOVERNMENT FARM, TOBAGO.

Berkshire	... Fee 50c.
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POULTRY.

GOVERNMENT FARM, TRINIDAD.

Eggs of Barred Plymouth Rocks, Black Minorcas, Brahmas (light), Rhode Island Reds, White Leghorns	... \$1.00 per doz.
Great Kind Pigeons	... 40c. and 60c. per pair.

GOVERNMENT FARM, TOBAGO.

Eggs of Plymouth Rocks, Black Minorcas, Rhode Island Reds	48c. per doz.
Also Cocks and Pullets of Plymouth Rocks and Rhode Island Reds.	

Department of Agriculture.

NURSERY STOCK.

Orders for Cacao, Coffee, Oranges, Grape Fruit, and Limes for next season should be sent in without delay addressed to the Acting Superintendent, St. Clair Experiment Station, or to the Officer in Charge Botanic Station, Tobago.

Special quotations at St. Clair for Cacao, Coffee and Limes grown from selected seeds are as follows :—

Plants purchased in lots of 1 to 1,000 plants	} Delivered at Nurseries uncrated.
8 cents per plant.	
Plants purchased in lots of several thousands	
2½ cents per plant.	
Plants purchased in lots up to 100 at 4 cents	} Delivered at Railway Station, Port-of- Spain or Queen's Wharf, securely packed in open crates.
per plant.	
Plants purchased in lots up to 1,000 at	
\$3.50 per 100.	
Plants purchased in lots of several thousands	
at \$23.00 per 1,000.	

Tobago prices on application at the Botanic Station, Scarborough.

Budded Avocados select varieties at 12 cents, Budded Oranges at 24 cents and Grafted Mangos at 24 cents should also be booked at once.

Budded Cacao 12 cents each or in lots of over 100 at 8 cents.

Limes from beds 1½ cents per plant for lots over 100.

A select stock is also kept of other fruit, ornamental and flowering trees, palms, etc., a list of which can be obtained on application. Large orders must be booked six months previous to the date when the plants are required as large supplies are not kept on hand for casual demands.

NURSERY STOCK LIST.

The new edition of this list giving prices of plants usually stocked at St. Clair Experiment Station can be had free on application.

THE BULLETIN.

The Bulletin is issued quarterly, price sixpence per number, or two shillings per annum post free in the Colony. To other subscribers postage extra. On sale at Messrs. Muir Marshall, and Davidson & Todd.

Subscriptions can be remitted by Postal Order, to the Acting Director of Agriculture, St. Clair Experiment Station. If so addressed they will come post free from within the Colony.

Part 1. 1918.—Report on St. Lucia Lime Factory. Storage of Black-eye Peas (Illustrated); Fruits of Trinidad and Tobago; Uses and culture of Dasheens (Illustrated, Prize Competition Reports, &c., &c.

Part 2. 1918.—*Coffea excelsa*, Yam cultivation, Insects affecting Vegetables, Rubber Tapping Experiments, Tobago Orchids, &c., &c.

Part 3. 1918.—Agricultural Co-operation in the West Indies; Agricultural Credit Societies; Sugar Cane Experiments; Trinidad Thrips, &c., &c., &c.

OUR LOCAL FOODS, Their Production and Use.

BY

W. G. FREEMAN, B.Sc., &c., and R. O. WILLIAMS.

Price 8d.

This pamphlet gives directions for the cultivation of the chief local food crops and treatment of pests; also recipes for the use of corn meal, sweet potatoes, dasheens, tannias, yams, cassava products, &c.; the preparation of meals and their use as flour substitutes; preparation of coconut butter, &c.

To be obtained from the Department or from Messrs. Muir, Marshall, or Davidson & Todd.

Board of Agriculture

PEST GANG.

The Board of Agriculture has in its employ a man who is trained in spraying, cutting out canker and cacao beetles, and other sanitary work. This man is available to teach such work to estate labourers. The wages of the man, while actually employed by the estate, are to be paid by the estate, but travelling expenses will be paid by the Board. Materials used in spraying will be supplied at cost price, and where possible, spray pumps will be lent.

From September to November is the time for spraying cacao trees for the prevention of thrips and black rot; and early in the dry season for the Algal disease and die back.

The Board of Agriculture has on hand a supply of bluestone, which is sold to planters at cost price plus 10 per cent., also nicotine sulphate, the best insecticide for thrips, which is sold at \$10 per gallon.

Further information in regard to Pest Gang, cost of spraying, etc., and applications for bluestone and nicotine sulphate should be made to

THE SECRETARY,
Board of Agriculture, Port-of-Spain.

BULLETIN
OF THE
DEPARTMENT OF AGRICULTURE
Trinidad and Tobago.

PART 3.]

1918.

[VOL. XVII.]

Agricultural Credit Societies.—Attention is directed to the reports on pages 127–33 of the Annual General Meetings of the Diego Martin, Pembroke, and Scarborough Credit Societies. Subsequent to June 30, the end of the financial year of the Societies, the Delaford Society has been registered, making three now in Tobago, and still more recently three other applications for registration have been received, one in Trinidad and two in Tobago. If these two are approved there will shortly be seven Agricultural Credit Societies at work in the Colony. The increase in number has not been rapid but it may well be that slow early growth may result more surely in lasting benefit than a forced development resulting in some failures and consequent discredit to the movement.

Great credit is due to the Officials of the existing societies for their voluntary efforts to create and maintain institutions which it is generally admitted will be of great benefit to the peasant proprietors. The need for such societies has recently come into prominence in the discussions on the Ordinance to prohibit the payment of wages other than in cash and do away with the system of giving labourers orders on shops, in lieu of money. Some critics of the Ordinance admit the evil of the shop order system, but suggest that it should be left—in a modified condition—until Agricultural Credit Societies are thoroughly established. It may well be however that the most powerful incentive to form Credit Societies would be the abolition of the shop order system. In any case there is a splendid opportunity for those who have the interests of peasant proprietors at heart, to encourage the formation of Agricultural Credit Societies in their own neighbourhood. The assistance of people of position or means, who have the confidence of their poorer neighbours would be of the greatest assistance in making the Credit Societies movement in this Colony the success it has undoubtedly been in many other countries.

Sugar Cane Experiments, 1916–18.—The report by Mr. J. de Verteuil on recent experiments with sugar cane varieties is given on pages 135–42. The advantage of reaping canes when properly ripe is shown in Table I by the results of testing canes at St. Augustine at monthly intervals from March to May. In several cases there was an increase of about fifty per cent. of sucrose per gallon in this period. For example D. 116 had it been reaped in March would only have given 1·031 lb. of sucrose per gallon of juice, whereas in May it had 1·626 lb. Other canes reached their maximum in sucrose contents in April and were over ripe in May. The following summary shows the yields of (a) plant canes in the season 1917–18 and (b) plant canes and

ratoons in the seasons 1916-17 and 1917-18. Of the sucrose yield given a factory would recover about eighty per cent.

<i>Sucrose in Juice.</i> <i>Tons per acre.</i>	<i>Plant Cane.</i> <i>Season 1917-18.</i>	<i>Average of Plant Canes</i> <i>and Ratoons</i> <i>1916-17 1917-18.</i>
Over $4\frac{1}{2}$...	B. 156.	
4 to $4\frac{1}{2}$..	T. 202.	
$3\frac{1}{2}$ to 4 ...	{ B. 208. D. 116. Ba. 6032 B. 347. B. 6308. D. 109.	H. 227. B. 208.
3 to $3\frac{1}{2}$...	H. 227. M. 1237. Badilla.	{ B. 6835. H ? B. 147. B. 156. Badilla. B. 3922. B. 347. D. 145. B. 6450. T. 75. B. 6308.
$2\frac{1}{2}$ to 3 ..	{ B. 4934. B.N.H. (02)1. M.P. 55 Striped. T. 75. B. 376. B. 6450. B. 6388. B. 3922. B.N.H. (02)5.	{ D. 501. D. 109. T. 39. H. 146. D. 116. B. 3390. B. 1753. D. 3956. H. 27.
2 to $2\frac{1}{2}$..	{ H.? White Tanna. B. 6835. H. 27 Bourbon. T. 30.	{ Bourbon. D. 366. B. 7169. T. 202. B. 4578. D. 2468. B. 4934. D. 115. B. 376. B. 3412. Ba. 6032. B. 16832.
$1\frac{1}{2}$ to 2 ...	L. 511. M. 90/03.	B. 6388.
1 to $1\frac{1}{2}$...	B. 7482.	

Sugar Production in Hawaii.—Hawaii has the distinction of producing the largest amount of sugar per acre, due to porous, basaltic soils, very thorough cultivation, extensive irrigation, and a very high level of efficiency in manufacture.

The following return taken from the *Manual of Hawaiian Securities* for 1918 shows that the production of sugar has increased from 289,544 tons (of 20,000 lb.) in 1900 to 649,786 tons in 1917. On non-irrigated plantations during this period, the yield per acre has ranged between 2.61 and 4.6 tons (of 2,000 lb.) per acre, and on irrigated plantations between 5.9 and 6.54 tons.

YIELD OF IRRIGATED PLANTATIONS.

<i>Year.</i>	<i>Acres.</i>	<i>Tons of</i> <i>Sugar.</i>	<i>Per Acre.</i>
1900 ...	27,090	166,002	6.127
1905 ...	48,663	295,798	6.078
1910 ...	55,973	350,996	6.270
1911 ...	57,382	369,718	6.448
1912 ...	58,399	377,145	6.45
1913 ...	57,775	342,233	5.928
1914 ...	60,056	392,967	6.544
1915 ...	60,688	395,022	6.509
1916 ...	61,181	388,049	6.34
1917 ...	62,979	404,719	6.42

YIELD OF NON-IRRIGATED PLANTATIONS.

Year.	Acreage.	Tons of Sugar.	Per Acre.
1900 ...	36,725	123.542	3.36
1905 ...	46,775	131,568	2.61
1910 ...	54,273	166,048	3.059
1911 ...	55,413	204,428	3.689
1912 ...	55,466	218,267	3.935
1913 ...	53,774	204,265	3.662
1914 ...	54,402	224,965	4.135
1915 ...	56,891	260,367	4.617
1916 ...	53,083	199,593	3.76
1917 ...	57,272	245,067	4.28

Average yield of irrigated and non-irrigated plantations for 1917, 5.85 tons of sugar per acre.

Agricultural Progress in Tobago.—The marked development of Tobago during the last twenty years is well shown by a comparison between the value of the exports of cultivated products in 1897 and those of 1916 and 1917:

	1897.	1916.	1917.
Cacao ...	1,671	47,672	32,847
Coconuts and products ...	776	11,439	14,486
Sugar and products ...	4,157	3,318	3,211
Rubber ...	Nil.	1,941	525
Tobacco ...	15	3,522	—
Corn, peas, starch, etc. ...	151	1,470	626
Vegetables and fruit ...	Nil	10,458	4,095
Bay oil and nutmegs ...	Nil	44	45
Totals ...	<u>£6,770</u>	<u>£79,864</u>	<u>£55,825</u>

In addition there were in 1897 direct exports from Tobago of the value of £5,000 making a total of £11,770.

The live stock industry has not made corresponding progress as seen below in the figures for the same three years. With the present rapid extension of cultivation, grazing areas are diminishing which may lead to a reduction in stock exports in the near future.

	1897.	1916.	1917.
Cattle ...	3,296	2,064	2,412
Horses ...	570	2,100	1,200
Mules ...	120	220	200
Donkeys ...	18	24	20
Sheep ...	241	693	933
Goats ...	594	357	485
Pigs ...	1,487	1,409	1,267
Dogs ...	22	95	53
Poultry ...	1,096	1,073	1,836
Eggs ...	not given	149	129
Hides ...	not given	225	203
Totals ...	<u>£7,694</u>	<u>£9,044</u>	<u>£8,746</u>

As regards cultivated products there are indications that the next twenty years may see an equally gratifying improvement. Cacao cultivation continues to expand and is attracting new settlers notably from Grenada. There has been a considerable extension of the area under coconuts some of which will soon be in full bearing. Limes are also being steadily planted and it is hoped that the establishment of a co-operative factory will materially develop this industry. The recent report of the Fruit Committee of the Agricultural Society may also help in the establishment of a trade for which conditions in Tobago are very suitable provided there are adequate transport facilities.

How rapid has been the progress in cacao cultivation is shown by the fact that as recently as 1906 in a pamphlet *Tobago, Hints to Settlers* prepared by Mr. J. T. Rousseau, then Warden, Captain M. Short, and Mr. H. Smith, then Hon. Secretary of the Tobago Planters' Association, and issued by the Imperial Department of Agriculture, it is stated that "the most promising industry of Tobago, just now, is cacao. When the young cacao, lately planted, comes into bearing, it is not unlikely that the produce exported will reach the value of £8,000 to £10,000." In 1916, only ten years later, the cacao exported from Tobago was of the value of £47,000. Due to the unfavourable season and lower prices there was a drop in 1917, but the cacao exports should ere long reach still higher figures, and there is also every hope that the present minor industries will develop rapidly to greater importance, and that new ones, such as limes, will arise.

Corn on Cob and Sword Bean Stock Feed.—Attention has at various times been directed to the use of corn on the cob. To make it a balanced ration it is necessary to add some product rich in nitrogenous matter or proteins.

Mr. H. Meaden, Manager Government Farm, Tobago, prepared a mixture composed by weight of Corn 1, Corn cob 3, and white Sword beans (*Canavalia ensiformis*) 1. It has been analysed by Mr. H. S. Shrewsbury, F.I.C., Acting Government Analyst, with the following result:—Composition: (per cent.) Ash 1.4, Fat 2.4, Protein 10.7, Moisture 11.7, Woody fibre 19.2, and carbohydrates 54.6. The total food units are 87.3 of which 61.0 are digestible. The latter may be compared with the digestible units in average pasture grass 46, in oats 73, and in corn (maize) grain 97. Mr. Shrewsbury adds "The sample represents a balanced stock feed of moderate food value."

White Sword beans have been used for stock-feeding for the last two years on some of the estates of the Usine Ste. Madeleine group.

The Digestibility of the Dasheen.—The following interesting note is taken from U. S. Department of Agriculture *Bulletin* No. 612. 1917. By C. F. Langworthy, Chief, and A. D. Hohnes, Specialist in charge of Digestion Experiments, Office of Home Economics.

"In ten digestion experiments with men, mature and immature dasheens were eaten in conjunction with common food materials in a simple mixed diet. The average co-efficients of digestibility for the total diet were: Protein, 80.8 per cent.; fat, 96.1 per cent.; and carbohydrates, 97.6 per cent.

"The value obtained for the digestibility of the carbohydrates, 97.6 per cent., which for all practical purposes represents the digestibility of the dasheen carbohydrates, compares very favourably with that of potatoes, the common vegetable most resembling the dasheen.

"The subjects of their own volition ate on an average approximately $1\frac{1}{2}$ pounds of dasheen daily without any observed physiological disturbances, which would indicate that considerable amounts of dasheens may be safely used in the dietary and that they are palatable.

"The results here reported were obtained from dasheens cooked by one method only; in the absence of data to the contrary it may be very well assumed that the dasheen is equally well digested when prepared by other methods similar to those employed with potatoes.

"The data obtained in this investigation give evidence to justify the belief that the dasheen is a valuable addition to the dietary, that it can replace the potato in those regions where the potato can not be successfully grown or easily obtained, and that it is also valuable for more general use to give greater variety to the diet in other localities."

The Value of Liquid Manure.—In the *Journal of the Board of Agriculture*, London, May 1918, the following note occurs:

"In view of the restricted supplies of nitrogenous manure every possible care should be taken of the liquid manure, especially in dairy farms. Repeated analyses have shown the value of the liquid, and long experience of farmers and direct experiments by investigators alike prove its usefulness as a fertiliser. In cases where the drains from the cow-sheds and stables run into a tank the system should be examined as early as possible so as to put it in order. If there is no tank an effort should be made to provide one. Probably 20 gal. per cow per week is a sufficient allowance for periods when the cows are in the shed all day, and of course a less amount when they are out of doors part of the time."

At River Estate alterations have recently been made whereby part of the old large stable is now used as a pen for the cattle of the public pasture and equipped with concrete pits for both solid and liquid manure.

The manure pit itself is $81\frac{1}{2}$ ft. by $10\frac{1}{2}$ ft. and $4\frac{3}{4}$ ft. deep and can hold 100 cartloads of pen manure, all the drainage of the stable and pen runs into it, and the surplus drains away again into the liquid manure pit which is at a lower level. This is 10 ft. by 5 ft. by 3 ft. deep with a capacity of 900 gallons. By the use of the pit the liquid manure will be saved instead of running to waste. Part will be put back periodically over the manure in the larger pit and the surplus used in the field on supplies and other plants which require special treatment. It is proposed later to fit the liquid-manure pit with a pump so that the contents may be the more easily removed.

Upland Rice.—The war has caused increased interest to be taken in the cultivation of Upland or Mountain Rice in Trinidad and Tobago. Other West Indian Islands have also taken up the crop and the Department has supplied seed to Antigua, Grenada, and St. Lucia. At the August meeting of the Agricultural and Commercial Society of Grenada it was decided to circulate 150 copies of the notes on Mountain Rice which have already appeared in this Bulletin (XVII, 1918, 71).

Ground Provisions Depôt at Tobago.—A branch of the Government Ground Provisions Depôt was opened on October 1 at Scarborough. As Tobago exports provisions to Port-of-Spain it is expected that business at the new depôt will consist mainly in purchasing produce for the Trinidad market but the scope will be extended if necessary. The buying prices will be posted weekly at the Botanic Station, Court House, Wharf and Market and in country districts which are on the telephone. As at the Port of-Spain Depôt all provisions will be purchased by weight. It is hoped that the new depôt will be of advantage to Tobago cultivators in affording them immediate cash payments for their produce. At first the depôt is being opened for business on the two days preceding the departure of the weekly mail for Trinidad, but all arrangements are tentative and will be modified should it be found desirable to do so in the interest of those for whose benefit the depôt has been established. The Depôt is under the supervision of Mr. H. Meaden, Officer in Charge of the Botanic Station and Manager of the Government Farm.

With reference to the crop for this year in Tobago the *Port-of-Spain Gazette* published the following note from its local correspondent on September 28, 1918 :

"We have always experienced a shortage of ground provisions just before the advent of corn, but this year's output, has completely wiped this hardship out, as the supply held good throughout the wet season. There is at present a full supply of yams, Guinea and Ebo. There are large areas cleared for cacao planting. These fields are first planted with foodstuffs and will produce a large crop for us in the near future. Our people have seen the great need of self-support, and are up and doing. Mr. Freeman's lectures and Mr. Agricultural Adviser Davies' good advice have had beneficial results. From better agricultural methods the food produced is of better texture and very much larger as far as size goes and we hope to still do better in the future and to be soon independent of imported foodstuffs."

Cleveland Bays as State Carriage Horses.—In a recent number of the *Field* there is a short article on "The State Carriage Horses" apropos of the Cleveland Bays which drew the royal carriage in the procession of the King and Queen to St. Paul's Cathedral on the occasion of their Silver Wedding. Up to quite recent times the State carriage horses were Hanoverian Creams or Blacks, now replaced by the typically English breed of which the *Field* remarks "the handsome Cleveland Bays now in use it is to be hoped will never be abandoned."

It is of interest to note that the latest importation to the Government Farms is a Cleveland Bay stallion "Rillington Spartan" who has been for a short time in Tobago and is now in Trinidad.

The following description of the Cleveland Bay is taken from *British Breeds of Live Stock* issued by the Board of Agriculture, London, 1913 :

"The Cleveland Bay is the oldest type of the large-size carriage horse, and has existed probably without much variation in the North and East Ridings of Yorkshire for more than 200 years. It has traces its

origin to Yorkshire cart mares, descended from the old English Black Horse or War Horse, and from a Barb Stallion, which later introduced the universal bay colour, and the dark dorsal stripe very often found. The evidence is not very exact but it is almost certain that Thoroughbred blood was introduced about the middle of the 18th century through a horse called Old Traveller, believed to be a Thoroughbred that travelled in the Yarm district.

"History of the Breed.—The breed sustained a serious blow when the development of railways reduced the demand for stage-coach horses, and when it became a common practice to breed carriage horses and other light-legged sorts by mating Thoroughbreds with small farm mares, but it was saved from extinction by being employed in farm work, for which in certain districts it has proved admirably qualified. The *Farmers' Magazine* for 1826 says: 'Probably the best horse for working the lighter class of soils is the Cleveland Bay, an original breed of the Country, neither Blood or Black, that is, a distinct race, from the English Blood-horse, and equally distinct from the Black or Cart breed of the country. It was the basis of the breed of the old London Coach-horse, when heavy cattle were used for these conveyances; and, after it became the fashion to adopt a lighter horse for carriages, this valuable breed was allowed almost to become extinct, till their excellence for agricultural purposes was noticed by some practical farmers in the north of England, who for several years have been exerting themselves to revive the breed.'

"Value for Crossing.—The great stamina and robustness of the constitution of the breed are valuable assets, and the mares are in high favour for crossing with a view to the production of either carriage horses or hunters.

"The favourite cross is perhaps that with the Thorough-bred horse, but for breeding carriage horses the Hackney stallion is also used."

Castilloa Scrap Rubber.—At the Agricultural Society on September 12 the recommendations of the Exhibition Committee were under consideration, including one that in order to encourage the small cultivator a money prize be offered for scrap *Castilloa* rubber in 1919. After a short discussion, the motion was rejected. Speakers in opposition to the motion expressed the views that nothing should be done to encourage the cultivation of *Castilloa* in any way, and that it deserved absolute destruction.

The whole ground has already been covered by the Rubber Committee of the Board of Agriculture, and as its conclusions are different from those represented by the vote of the Agricultural Society it may be well to summarise them here from the Report of the Committee (*Bulletin* XVI, 1917. 118-28).

"*Castilloa* and Cacao interplanted are to be found throughout the Colony. The opinion is widely held that the two plants do not thrive together and that the *Castilloa* injures the Cacao. This opinion, combined with the fact that *Castilloa* has not given the yields which planters were led to expect, has caused a violent reaction against this plant. On many estates *Castilloa* trees have been ruthlessly cut down,

probably in thousands, during the last few years, as being not only worthless in themselves, but absolutely injurious to the Cacao amongst which they were growing.

"From a careful examination of the evidence the Committee has come to the conclusion that this condemnation is too general and that in suitable districts, planted under suitable conditions, and properly treated, *Castilloa* and Cacao thrive together, do not injure each other and each yields a remunerative return. Four actual examples from prominent estates will serve to demonstrate this point."

Returns are then given showing that at Verdant Vale, Arima three of the best cacao fields have *Immortels* and *Castilloa* and cacao. Similarly two fields at Monte Cristo, Tamana. At Roxburgh, Tobago a field of cacao planted 16 ft. by 16 ft. is shaded with *Castilloa* alone at 32 ft. by 32 ft. Returns have been kept of the yield of the 7 plots into which the field is divided for future use in experimental work, and at 14 years old the worst plot gave 23 bags (of 165 lb.) per 1,000 trees and the best 33 bags.

At Richmond Estate, Tobago "no manure" experiment plots of mixed *Castilloa* and Cacao (11 years old in 1911) gave 13, 10, 10, and 14 bags per 1,000 trees in the four years 1912-15.

The report continues "On the other hand there are without doubt examples in the Colony of the mixed cultivation of *Castilloa* and Cacao which have proved anything but remunerative; the yield of the cacao is stated to have been poor and not compensated for by the returns from the rubber. The causes of failure probably differ in different cases, but the general impression left on the Committee is that the principal cause was overcrowding. Take as an example one estate in Trinidad in which *Castilloa* and Cacao had been cultivated together on a large scale, there were *Immortels* at 36 feet by 36 feet with *Castilloa* between at 18 feet by 18 feet, and Cacao at 15 feet by 12, i.e. to the acre about 242 Cacao trees, and about 160 *Castilloa* and *Immortels* to shade them (in a wet district where only a light shade is really needed) and also to compete for nourishment from the soil. No wonder Cacao under such circumstances has done badly. It would have fared badly had it been so densely shaded with *Immortels* alone, and would have improved greatly had a great number of them been removed. This would not however prove that *Bois Immortel* and Cacao do not thrive together. The course which recommends itself to us under such circumstances is not the sudden and wholesale destruction of the *Castilloa*, but the removal of some of the *Bois Immortel*, the periodical trimming of those left, and the judicious thinning out of the *Castilloa*, so as to leave the medium shade suited to the local conditions."

The conclusions of the Rubber Committee regarding *Castilloa* were :

"1. That the planting of *Castilloa* as a pure crop is not profitable anywhere.

2. That the further planting of *Castilloa* even as shade for Cacao is inadvisable, except on or near estates where it is already proved that *Castilloa* can be so grown without injury to the Cacao crop, while returning some revenue itself.

3. That where Castilloa has already been established and makes vigorous growth, it will pay to tap it.

4. That the right method of tapping Castilloa has never been found, and probably never will be found: but that further experiment is desirable; and that the Merchiston method should be watched with interest.

5. That the most profitable method appears to be tapping, two or three times a year, in dry weather, with the cutlass, and collecting the rubber four days later in the form of "scrap-ball."

6. That the cuts should be made about one foot apart, on one side of the tree only, and made obliquely *upwards* in order to prevent rotting due to the entry of rain.

7. That where Castilloa is alleged to injure Cacao, such injury is frequently due to excessive shade, either of Castilloa alone, or of Castilloa plus immortels.

8. That, before, in such cases, condemning the Castilloa off hand it would be well to try the effect on the Cacao of the reduction of shade.

9. That the tapping of isolated Castilloa trees in certain places might be profitably conducted on similar lines to the bleeding of balata."

No facts were brought forward at the Agricultural Society's discussion to invalidate these conclusions. On the other hand those who have continued or recently taken up the preparation of scrap Castilloa have found it profitable.

W. G. FREEMAN.

CO-OPERATION.

AGRICULTURAL CO-OPERATION IN THE WEST INDIES.

By W. G. FREEMAN, B. Sc., A.R.C.S.,
Acting Director of Agriculture.

IN many parts of the world, including the tropics, Agricultural Co-operative Organizations play an important part and have proved of great benefit to cultivators both large and small. No less than three such enterprises are under consideration in this Colony at the present time: (1) the Government Co-operative Lime Factory for Tobago, (2) the Trinidad and Tobago Co-operative Fruit Growers' Association, and (3) a Co-operative Sugar Factory for Trinidad.

The first has been decided upon and awaits favourable conditions for its establishment (*Bulletin* XVII, 1918. 59). The second has been recommended by the Agricultural Society and a working scheme is under consideration (*Bulletin* XVII, 1918. 58). The third has been considered and reported upon by a Committee of the Agricultural Society. (*Proceedings Agricultural Society*. October 1918; XVIII, 894-902).

Under these circumstances it will doubtless be of interest and service to give a short account of some of the Agricultural Co-operative Organizations already at work in the West Indies, other than those for Co-operative Credit.

COCOA PLANTERS' ASSOCIATION OF TRINIDAD.

The "Cocoa Planters' Association of Trinidad Limited" places amongst its objects: "To obtain for the members of the Association the advantages which are to be derived from mutual help and co-operation." At present the work of the Association is mainly confined to the sale of the produce of its members. Any Planter in Trinidad and Tobago may apply to become a member, using the following form:

- "(i.) I the undersigned agree to become a member of the Cocoa Planters' Association of Trinidad, and to be bound by the Articles of Association for the time being in force.
- "(ii.) I agree to be registered in respect of the cocoa grown on the estate situate in the Ward of and on all other parcels of land which may hereafter be added to and worked together with the said estate.
- "(iii.) I undertake to deliver to the Association all the cocoa picked from the said estate and any additions thereto, as and when the same shall be fit to be delivered, and not to sell or dispose of any cocoa picked from the said estate or any additions thereto, to any other person or persons. I estimate my crop to be bags of 165 lb. net."

Signed.....

Witness:

The Directors have power to refuse any application if they think it is undesirable that the Association should undertake the sale and disposal of any of the products of the applicant.

The Association grades and bulks produce, *e.g.* cacao delivered by its members and the proceeds less working expenses are divided amongst members according to the amount delivered by each. Members are paid about nine-tenths of the value of their produce (less estimated working expenses) on delivery to the Association and the balance after the year's accounts have been made up.

The Association has also for some time procured estate supplies, etc. for its members, and proposals have recently been considered for developing this side of its activities.

The last Annual Report of the Association shows that in 1916-17 it dealt with the produce of 75 estates aggregating a total of 4,381,905 lb. of cacao. River Estate (worked by the Department of Agriculture) disposes of its produce through the Association.

Since the close of the year 1916-17, the membership has increased to 92, and the Association now deals with the produce of 107 estates.

ST. LUCIA CREDIT SOCIETIES DEALING IN CACAO.

In St. Lucia some of the Agricultural Credit Societies have made use of the regulation which allows of the sale in common of the produce of members. In the year ending March 31, 1917 two Societies were working in this way and they shipped 65 bags of cacao. In the following year five Credit Societies disposed of the produce of members on a co-operative basis, shipping altogether 174 bags of cacao and small amounts of sugar and kola.

The method is capable of great extension, and so far as Trinidad and Tobago are concerned our Ordinance provides similar facilities to those which have already been made use of in St. Lucia, it being laid down in Rule VI that the Committee of Management "shall also have power to decide questions concerning (a) the purchase in common of farming requisites and (b) the sale in common of farm produce." Attention has been directed to this form of co-operation at various meetings of small proprietors and others but as yet no action in this direction has been taken in the Colony.

GUNTHORPE'S SUGAR FACTORY, ANTIGUA.

In sugar enterprises it is necessary to secure, by mutual interest, the co-operation of the growers of the canes and the manufacturer. In the Gunthorpe's scheme this was attained in the following manner:

(1.) A company formed in London agreed to erect a factory, capable of making not less than 3,000 tons of sugar in a season of 100 days, and local sugar estate proprietors, the "original contracting proprietors," agreed to sell their canes from a stated acreage for a period of fifteen years. The proprietors were to receive as first payment the price of 4½ lb. of 96° sugar for every 100 lb. of canes and half the profits made by the factory after allowing for working expenses, interest and sinking fund. If the first payment was less than 10 shillings per ton of

(1.) See "Review of Ten Years Work of the Antigua Sugar Factory (Gunthorpe's) by Dr. (now Sir) Francis Watts, *West Indian Bulletin* XV, 1916, 47-68.

canes the amount was to be made up, if possible, to that figure at the end of the season before any division of profits took place. The sinking fund was planned to redeem the capital in a period of fifteen years and at the end of that time the original contracting proprietors are to receive shares equal in number to the original shares of the Company. The Antigua Government contributed £15,000 being a part of the Imperial Grant-in-Aid of the sugar industry, to be written off without payment at £1,000 per year so long as the factory fulfills its conditions.

The factory has been increased greatly since its foundation, and other estate proprietors called "new contracting proprietors" have since come in who supply canes on the basis of the value of 5 lb. of sugar per 100 lb. of cane and participation in the half-profits, but do not receive any share in the ultimate ownership of the factory. The factory has also encouraged peasant cultivators or cane farmers but in the earlier years droughts and low prices greatly hampered this development.

The following table shows the development which has taken place in the capacity of the factory, and the prices paid to the estate proprietors for their canes:—

YEAR.	Crop Tons Sugar.	Price of Sugar per ton.	PRICE PER TON CANE. FIRST PAYMENT AND BONUS.		
			Original Contracting Proprietors.	New Contracting Proprietors.	
		£ s. d.	£ s. d.	£ s. d.	
1905	1,634	12 15 5	14 1		
1906	2,349	8 4 8	7 5		
1907	4,231	9 16 0	12 3		
1908	4,696	11 15 9	15 11		
1909	3,995	10 7 5	14 0		
1910	5,390	12 16 8	18 1½	14 6	
1911	5,472	10 11 5	10 10½	12 2	
1912	6,239	13 5 3	16 10½	15 10½	
1913	7,337	9 8 7	11 3½	10 8	
1914	9,131	9 1 6	11 3½	10 7½	
1915	8,390	16 7 9	1 5 8	1 1 5	
1916	12,372	...	1 10 1½	1 4 11½	
1917	11,705	..	1 16 0	1 9 1	

As stated by Sir Francis Watts in the review of ten years' work, already referred to, "The history of the factory has been one of continuous growth whereby from the 3,000 ton factory originally planned there has evolved a factory with a capacity of some 10,000 tons.

"The continuous growth has involved much careful work in the way of finance; it has been necessary largely to increase the capital of the Company which was originally £45,000 and now stands at some £110,000; the original cost of the factory was £48,860 while the factory as it now stands represents with its railways an expenditure of some £108,000, together with some amounts which have found their way into

annual working charges as repairs and maintenance, amounts which probably aggregate some £17,000, so that the factory may be taken as costing approximately at £120,000.

"There have been some favourable circumstances which have tendered to minimise the cost of construction connected with the factory; for instance, the expense of erecting sugar stores and shipping quays has been avoided as storage and shipping are done under contract with owners of premises in St. John's, the shipping port: in the construction of the railway there has been no very difficult work so that the cost for bridges, cuttings and embankments has not been unduly high: in the matter of the water supply too the factory has been reasonably fortunate in that it has been found possible to construct ponds for water storage at a moderate cost on account of the retentive nature of the stiff clay existing near the factory: no heavy expenditure was incurred in acquiring land for the factory and its associated buildings, as an uncultivated site was chosen it was purchased at the low price of £5 an acre. All these matters have tended to keep down the capital charges.

"Notwithstanding the expenditure of the large sum above referred to the charges for interest have been extremely moderate in the aggregate, being £13,661 for debenture interest and £6,012 for interest on other capital. By skilful finance the capital has been provided at a very moderate charge so that any suspicion that the capitalist might desire to exploit the cane grower may be dispelled.

"From a financial point of view the factory must be regarded as being in a strong position and it is demonstrated that a well managed factory, working on profit sharing lines is a safe and remunerative investment even in times of low prices, provided that an adequate supply of canes is assured so that the factory may make an out-turn reasonably proportioned to its capital outlay, and it is hoped that the working of this factory may have made the fact so clear that the difficulties experienced in obtaining capital for sugar factories in these islands may be greatly reduced."

ST. LUCIA GOVERNMENT LIME FACTORY.

THE working of the St. Lucia Government Co-operative Lime Factory has recently been described in detail in this Bulletin by Mr. H. Meaden as the result of his visit in December 1917 (*Bulletin* XVII, 1918, 4-18). The original cost of the factory and of the subsequent extension was defrayed by the local government, and is being paid off, the first portion by a charge of 10 per cent. (interest and sinking fund) over ten years and the latter by a charge of 5 per cent. over twenty years.

Limes and lime juice are received and a first payment made at the time of delivery. After the profits of the season have been ascertained, one-fourth share of them is carried to a Factory Reserve fund and three-quarters divided as a bonus between the vendors in proportion to the quantities of limes and lime juice delivered.

The *Annual Report* on the Agricultural Department, St. Lucia 1917-18 gives the following financial statement of the results of the

season ending March 10, 1917. That for the previous season's crop has been published in Mr. Meaden's report already referred to :

RECEIPTS.				£	s.	d.
Net proceeds from the sale of concentrated lime juice and lime oil	...	...	...	1,409	7	7
EXPENDITURE.						
Paid for produce	...	...	...	593	13	6
				£	s.	d.
Working Expenses	...	...	...	121	10	3
Labour, including salaries of management	...	...	...	121	10	3
Fuel and Oil	...	...	...	100	12	7
Packages	...	...	...	32	2	2
Export duty and sale of produce	...	...	...	30	7	7
Insurance on buildings and machinery	...	...	...	12	12	0
Contingencies	...	...	...	22	12	5
Total	...	...	...	£	913	10 6
<i>Other Charges :</i>						
Contribution to General Revenue for Supervision of Agricultural Officers, etc.	...	...	...	30	0	0
Interest and Sinking fund on Loan £350 @ 10%	...	...	...	55	0	0
Depreciation fund 5 per cent. on £514 2 11	...	...	...	25	14	2
Special remuneration to Government Officers whose duties have been increased	...	...	...	30	0	0
Interest and Sinking fund on £865 12 4 part spent of loan No. 2	...	...	...	30	1	10
Total expenses	...	...	...	£	1,084	6 6
Total Receipts	...	...	...	1,409	7	7
Total Expenses	...	...	...	1,084	6	6
Difference	...	...	...	£	325	1 1
Less amount as deferred payment bringing first price paid for produce up to rate equivalent to £25 per pipe	...	...	...	196	0	0
Net profits	...	...	...	£	129	1 1
Quarter share of profits to go to Factory Reserve Fund	...	...	...	£	32	5 3½
Three quarter profits to be divided as bonus between vendors	...	...	...	£	96	15 9½

As deferred payment and bonus the vendors received further payment at the rate of 1s. 5½d. per barrel of fruit and 2½d. per gallon of raw juice, thus making a total payment of 4s. 5½d. per barrel of fruit and 6½d. per gallon of raw juice.

BRITISH GUIANA GOVERNMENT LIME FACTORY.

The establishment of a Government Co-operative Lime Factory founded on the model of that at St. Lucia was decided upon in March, 1915, when the Combined Court of British Guiana voted £645 16 8 for its erection and equipment. The factory was erected at the Government Industrial School, Onderneeming and began operations in July, 1916. In the first six months ending December 31, 1916, it purchased 1,605 bags of limes, 750 from the Onderneeming Farm and 845 from farmers and other growers.

In the year ending March 31, 1918, its operations increased to 3,504 bags of limes, and although the price of lime products had fallen the net profit for the year was 16 per cent. on the capital outlay. The factory has also proved of service in other ways, and has been used as a source of power for a coffee pulper and huller, a grain mill, and a rice huller and polisher, all of which have been installed in the same building.—(*Annual Report*, 1917-18).

ANTIGUA LIME GROWERS' ASSOCIATION.

In Antigua the interest in limes is not large but in order to endeavour to develop a trade in green limes for which New York is the market, a Lime Growers Association was formed in October 1916. Amongst the objects of the Association are the provision of a central packing and grading place, looking after shipping accommodation and freights, and the appointment of an agent in New York.

COTTON GROWERS' ASSOCIATION, ANTIGUA.

This Association was formed in May, 1916 and all the prominent growers of cotton in the island are members. The objects of the Association are to safeguard the interest of cotton growers and generally to further those of the industry. The operations of the Association include the ginnery and baling of cotton. A first payment is made for the seed cotton, and the net profits at the close of the season (less 25 per cent.) divided in proportion to produce delivered.

In addition to this ordinary co-operative trading work the Association has arranged for the supply of selected seed for planting. In the year 1916-17 about 1,400 lb. of such pedigree seed were thus sold.

GOVERNMENT COTTON GINNEY ST. VINCENT.

Soon after the revival of the cotton industry in the West Indies in 1903, by the efforts of the Imperial Department of Agriculture and particularly of Sir Daniel Morris, a Central Cotton Factory was erected in St. Vincent and placed under the charge of the Agricultural Superintendent. In the year 1909-10 its operations were extended by opening it also for the purchase of seed cotton from growers on a co-operative or profit sharing basis. This was soon appreciated by the small growers as shown by the fact that 93,850 lb. of seed cotton were dealt with under this scheme in 1909-10, 296,089 lb. the following year and 510,932 lb. in 1911-12. In 1912 the Agricultural Superintendent re-inquired the control of the ginney and a separate manager was appointed.

GOVERNMENT GRANARY ST. VINCENT.

A Government Granary was founded at St. Vincent in 1916 in connection with the Government Cotton Ginney, to deal in corn on a co-operative basis. The following are the rules as published in the *St. Vincent Government Gazette* for September 30, 1916. (1)

- "1. Only good yellow corn will be purchased.

"2. Corn will be bought on a profit-sharing basis as follows :—

- (a.) Lots in lesser quantities than 25 lb. of corn on the cob or 20 lb. of shelled corn will not be bought, except from those persons who have previously sold corn during the then current season.
- (b.) Corn will be paid for at the rate of 3s. 4d. for every 100 lb. of first grade corn on the cob or ½d. per lb. for shelled corn. This price is subject to market fluctuations.
- (c.) Any profits after paying all expenses will be divided by way of bonus, 75 per cent. to sellers and 25 per cent. to the Ginnery.
- (d.) All corn bought for sale on the profit-sharing system must be clean, sound, and well sun-dried. Corn on the cob must have the husk removed. Second grade corn will not be accepted under any conditions.

3.—(a.) Corn will also be received at the Ginnery for shelling and drying at a charge of 4½d. for every bushel of 56 lb. returned to the sender, and

(b.) Shelled corn received for drying only will be charged for at the rate of 4d. per bushel of 56 lb.

(c.) Senders must provide their own bags.

(d.) A notice of intention to send corn for shelling and drying, or for drying only, must be given not less than two weeks in advance, and corn will only be accepted by arrangement with the Manager within the capacity of the machinery. Any kiln-dried corn left at the Ginnery for more than one week will be charged for thereafter at the rate of 1d. per cwt. per week.

(e.) Kiln-dried corn will not be stored for more than a fortnight.

4. Shelled corn will be ground into meal at the rate of ¾d. per gallon."

In the *Annual Report* on the Agricultural Department of St. Vincent for 1916-17, the following summary is given of the results of the co-operative dealings in corn for that year's crop :

STATISTICAL.

Total weight of cob corn taken	...	53,647 lb.
" " shelled corn taken over...	...	38,753 lb.
" " kiln-dried corn obtained.	...	71,804 lb.
" " " meal sold	...	63,941 lb.
" " " corn on hand	...	1,249 lb.
Number of persons who supplied corn	...	130
Average moisture content of wet grain corn	...	15·5 per cent.
" " " " cob corn	...	17·6 "
" " " " kiln-dried corn	...	10 "
" amount of corn to cob by weight	...	75 to 77 "
Estimated loss of weight of corn in store	...	2 to 3 "
" " " " kiln-drying	...	6·5 to 7 "
" " " " in grinding corn to meal...	...	6·5 "

FINANCIAL.

Price paid on account for cob corn	3s. 4d. per 100 lb.
" " " grain	½d. per lb.
Total amount paid on account for corn... ..	£170 9s. 11d.
" " realised by sale of meal and corn	£523 17s. 2d.
Sale price of meal..	15s. 7½d. per 100 lb.
" value of corn on hand (1,249 lb. Govt. Reserve)	1½d. per lb.
Expenditure on grinding, drying, etc.	£62 1s. 2d.
" labour, materials, etc.	£27 2s. 7d.½
Profits on transactions	£264 3s. 6d.
Bonus paid to growers, being approximately three-fourth of profits calculated on the price paid on account	120 per cent.*
Total amount per lb. of grain corn	2½c. per lb.
Rate charged for grinding	1d. for 7 lb.
" " kiln-drying	4d. for 56 lb.
" " shelling	½d. for 56 lb.

CO-OPERATIVE PURCHASE OF COTTON AND CORN IN ST. VINCENT.

The following interesting note is taken from the *Agricultural News* XVII, 1918, 231:—

"A further example of the value of co-operative work in agriculture to the small grower is exhibited in some recent developments connected with the co-operative purchase of cotton and corn at the Government Ginnery in St. Vincent. Mr. W. N. Sands, Agricultural Superintendent in that island, in forwarding the information below, remarks that the small grower of cotton usually requires all his available ready cash for planting his land, so that if he can obtain corn meal for food, and seed for planting, on credit, he is encouraged to do his best in improving his cultivation with the resources at his disposal.

"During the 1917-18 season 1,427 pass books were issued to growers selling seed-cotton to the St. Vincent Government Ginnery and Granary on a profit-sharing basis, and 346 to those selling corn, making a total of 1,773, many of which contained several entries. The transactions connected with the purchases are not yet complete, so that the actual figures are not available, but approximately the sales amounted to 223,920 lb. of Sea Island seed-cotton : 132,000 lb. of Marie Galante, and 147,840 lb. of wet grain corn.

"In order that the sellers of both cotton and corn might obtain kiln-dried corn meal for home consumption at a time when local foodstuffs were comparatively scarce and dear, and during the period when planting operations were in progress, a new scheme was inaugurated in June last at the granary under which any person who sold cotton or corn to the amount of \$6.25 and \$5, respectively, might obtain on credit 25lb. of corn meal at the rate of 5c. per lb. on the security of his prospective bonus. These were the minimum amounts for which corn meal was issued, but larger quantities could be obtained in proportion to the value of the sales made.

* 120 per cent. is slightly larger than the balance sheet shows, but it was deemed good policy to pay it.

"The scheme is working well, and is likely to have an excellent effect on the growing of both cotton and corn by the peasantry in the Colony.

"For the past two seasons it has been possible for the small grower to obtain on credit at the ginners all the cotton seed he required for planting. This had a most beneficial influence, because it practically assured the planting of seed from a selected strain of good ordinary Sea Island Cotton, and greatly facilitated the grading of the cotton when offered for sale."

ONION GROWERS' ASSOCIATION, ANTIGUA, &c.

This co-operative Association was founded in 1918 and extended in 1915 by the creation and affiliation of similar associations in Montserrat, Nevis and the Virgin Islands. The members of the Antigua Association are sugar estate proprietors who also grow onions. The Association is financed by loans from local merchants, members subscriptions and the transfer of three per cent. of the profits to a reserve fund. The Government has given assistance by providing a small building and the Agricultural Department undertaking the secretarial work.

Onions as dug from the field are delivered at the central depot, and a first payment made of \$1.00 per 100 lb. They are cured, graded, packed and shipped by the Association, which receives fortnightly cable advices as to the state of the market from New York, Canada, Trinidad, and Barbados, and periodical cables from other places. The Association defrays all working expenses and the profit, less the three per cent. carried to reserve, is divided amongst members according to the quantity of onions delivered.

In 1917 the number of crates of onions shipped was 5,664, and the net proceeds realized \$15,608.48 or \$2.80 per crate. The bonus distributed at the close of the season was \$2.94 per 100 lb.

Affiliated Associations in Montserrat, Nevis and the Virgin Islands are worked on the same general principles.

AGRICULTURAL CREDIT SOCIETIES.

THE Agricultural Credit Societies Ordinance 1915 (see *Bulletin* XV. 1916. 35-55) came into operation by Proclamation on Empire Day May 24, 1916. The first Society to be formed was Diego Martin, registered on October 12, 1916 with fourteen original members. Three other Societies have since been formed Pembroke, Scarborough and Delaford, all in Tobago.

The financial year of the Societies ends on June 30, and reports follow of the Societies which were in existence previous to June 30, 1918. In the case of Diego Martin the financial statements for two years are given:—

DIEGO MARTIN AGRICULTURAL CREDIT SOCIETY.

Report of the Annual General Meeting, 1918. (1)

The Annual meeting of this Society was held at Diego Martin on Sunday, August 25. Fifty-seven members were present. Mr. W. G. Freeman, Registrar and Mr. Ludovic de Verteuil, were present as visitors.

The Chair was taken by the Chairman of the Society (Mr. E. B. Jago) at 8 p.m. The Chairman opened the meeting by reviewing the work of the Society. He drew attention to the most satisfactory work of the Committee, who had given careful attention to the business of the Society, and pointed out that the present satisfactory state of the finances were entirely due to the carefulness of the methods of granting loans.

The Chairman also emphasised the great importance of members meeting their liabilities promptly, so as to enable the Society to work on a minimum of borrowed capital. The success of the Society depends on the individual interest displayed by members and a fostering of the spirit of co-operation.

He urged the members not to regard the Society as a money lending concern, but as a Society, whose sole object was to help one another, by small cash advances in time of need, and by meeting together to talk over and discuss their difficulties. The Chairman then reviewed the financial state of the Society and gave the following facts:

Since the commencement in December 1916, the Society has advanced to its members the sum of \$2,400, of this sum, \$1,827.80 was out in loans on June 30, 1918.

The reserve fund of the Society on this date was \$112.30, and the total earnings, after paying all expenses, amounted to \$173.22.

The capital has been borrowed as follows:—\$960 from the Royal Bank of Canada; \$900.00 from private sources. During the year ended June 30, 1918 \$550.00 of capital previously borrowed has been repaid. During the past year eighty-four loans were granted, and he was glad to say that so far the Society had sustained no losses.

The members then postponed the consideration of the Balance Sheet to next meeting, and the general business was proceeded with.

Mr. Freeman addressing the meeting said he was very pleased indeed to hear the most interesting and satisfactory review of the Society's work, and congratulated all members on their success. He referred to the great interest taken by their Chairman and said that he was sure the members felt that the success of the Society was due in a large measure to his work. When he addressed their Society last, Diego Martin was the only one in the Colony, but now three had been started in Tobago and he felt sure that the lead given by Diego Martin would be the means of assuring others to follow in their good work. He asked members to do all in their power to carry on the work that had been started and to remember that any dishonesty would mean that they were robbing themselves. He referred to the pleasure it gave him to see Mr. de Verteuil present that day, as Mr. de Verteuil was known as the pioneer of these societies in this colony. He urged members to keep up the Reserve Fund, so as to uphold the credit of their Society and make it easy to obtain capital. They must also be punctual in their repayments of loans, as this would enable the Committee to make the best use of their money and so in time lower the rate of interest to members. Mr. Freeman concluded by congratulating the Society on having voluntary officers as that meant the officials were doing their work, simply out of regard for the welfare of the Society. He assured them of his deep interest in their work and of his readiness to help or advise at any time.

Mr. de Verteuil then addressed the meeting and said that it gave him the greatest pleasure to be present this afternoon. As long ago as 1899 he commenced to try and establish these Banks in the Colony, and now thanks to the great help of Mr. Freeman they were actually in existence. He congratulated the society upon its excellent work and its capable Chairman. He asked members to look upon the society as a symbol of christian socialism and urged them to practice honesty and mutual help. He regarded a Credit Society as a social institution of great power if members realised the ideals, and he saw in the Diego Martin Society a great power for good in the district and an example to the colony of what can be done by earnest work and good fellowship. . . .

The following resolutions were then passed :—

1. All interest to be payable in advance.
2. The capital for the ensuing year to be £600.
3. Rate of interest to members to be 10 per cent.

Mr. Charles in a few well chosen words thanked the Chairman on behalf of the society and the Chairman thanked Mr. Freeman and Mr. de Verteuil for their kind remarks and encouragement, and also for their ready offer of help at all times.

NOTE ADDED BY CHAIRMAN.

At a meeting held on September 8, 1918 the following business was transacted :—

The Balance Sheet to June 30 was adopted and the sum of \$37.20 was placed to the Reserve Fund from the Profit and Loss Account, making the total Reserve Fund on that date \$150.00.

3 members were ejected, and five new members elected. It was announced at this meeting that the Society had no bad debts in its Books.

THE DIEGO MARTIN AGRICULTURAL CREDIT SOCIETY.

Statement of Receipts and Payments from August 1916 to June 30, 1917.

RECEIPTS.		PAYMENTS.	
	\$ c.		\$ c.
Members Interest on Loans	143 12	Loans to members	1,843 00
Loans to Society	1,310 00	Loans to Society repaid	100 00
Reserve Fund	92 00	Charges account	38 31
Loans to members repaid	341 50	Interest paid on Loans to Society	36 40
		To Balance in Bank on 30/6/1917	131 37
		To Cash on hand 30/6/17	237 54
	<u>\$2,386 62</u>		<u>\$2,386 62</u>

(Sgd.) ERNEST B. JAGO,
Chairman and Treasurer.

Examined and found correct.

(Sgd.) R. G. DUSHE,
Auditor-General.

September 28, 1917.

Balance Sheet at June 30, 1917

LIABILITIES.		ASSETS.	
	\$ c.		\$ c.
Loan from Royal Bank		Loans to members	1,501 50
Canada	980 00	Cash in Bank	131 37
Loans from private sources	750 00	Cash in hand	237 54
Reserve Fund	92 00		
Profit and Loss account	68 41		
	<u>\$ 1,870 41</u>		<u>\$1,870 41</u>

(Sgd.) ERNEST B. JAGO,
Chairman and Treasurer.

Examined and found correct.

(Sgd.) R. G. BUSHÉ,
Auditor-General.

September 28, 1917.

MEMO.—RESERVE FUND.

(1.) Under Regulation XII any sums to the credit of the Reserve Fund must be placed on deposit in a Bank. This has now been done in this case.

(2.) The Reserve Fund under the same Regulation is to be credited with at least ten per cent. of the annual net profits, which has now been done.

11/10/17.

(Initld.) R. G. B.

Statement of Receipts and Payments from July 1, 1917 to June 30, 1918.

(Certified as correct by the Hon. Auditor-General).

RECEIPTS.		PAYMENTS.	
	\$ c.		\$ c.
Balance in hand 30/6/1917	368 91	Loans to Members	1,900 50
Members Interest on Loans	210 53	Loans to Society repaid	550 00
Loans to Members repaid	1,574 20	Charges Account	49 62
Reserve Fund	13 50	Interest on Loans to Society	110 00
Loans to Society	700 00	Cash in Bank	49 57
		Cash in Savings Bank	110 30
		Cash in hand	97 75
	<u>\$2,867 14</u>		<u>\$2,867 14</u>

Balance Sheet at June 30, 1918.

LIABILITIES.		ASSETS.	
	\$ c.		\$ c.
Loan from Royal Bank of Canada ...	960 00	Loans to Members ...	1,827 80
Loan from private sources ...	900 00	Members Interest to Society ..	84 45
Reserve Fund... ..	112 30	Cash in Bank ...	49 57
Profit and Loss account ...	173 22	„ Royal Bank Savings account ...	110 30
Interest due to private lenders	24 35	„ hand	97 75
	<u>\$2,169 87</u>		<u>\$2,169 87</u>

PEMBROKE AGRICULTURAL CREDIT SOCIETY.**Chairman's Report for the twelve months ending
August 23, 1918.**

EARLY in the year 1917, several peasant proprietors of Pembroke met together at the residence of the Agricultural Adviser to consider the possibility of opening an Agricultural Credit Society.

Having discussed the Ordinance the Agricultural Adviser offered to keep the shares paid by those who cared to become members, until we could get the minimum number required by the Ordinance, when we could apply for registration.

The members of the Windward District Agricultural Society had the pleasure of an address by the Acting Director of Agriculture and Registrar of Agricultural Credit Societies, Mr. W. G. Freeman, on the subject of the Credit Societies. This address acted as a stimulus to the promoters of the Pembroke Society, and in May 1917 we were able to apply for registration with a membership of seventeen; electing as our officers: Samuel T. Muir and Charles E. McPherson, Trustees; Esau Biggart, Secretary; Charles H. Dann, Treasurer; F. D. Davies, Chairman; and these officers with James Titus, Samuel McEwen, John Franklin, Geo. Murray and James D. Martin to form a Committee of Management.

To facilitate the work of the Registrar's Committee of enquiry, a delegation was asked to make an appointment and call on Mr. H. P. C. Strange, the Commissioner-Warden to lay the matter before him, asking his support and advice; also to hand him, for his information, Deeds of Conveyance of every member as our list then stood. I cannot fail to record here our thankfulness to the Commissioner-Warden for his kind reception.

In the month of June, the Committee of enquiry consisting of the Registrar, the Warden, Captain Short, Messrs. Murray and Archibald, considered our application, to whom we are thankful for their favourable opinions. The Registrar on this occasion again addressed the members at the Roxburgh Court House on their venture, and wished them success.

Registration was granted in June, and the Secretary was instructed at a general meeting held in July to write to the Board of Management, asking for a loan of \$480.00 and permission to raise another \$480.00

from private sources. In reply to this request, we were soon after informed, that the Board of Management would grant a loan of \$240.00 and when the Society raised a like sum from other sources we could have another \$240.00.

On August 16, 1917, we started business, receiving from the Board of Management \$240.00 at 6 per cent.; the Royal Bank of Canada \$144.00 at 7 per cent., and Charles H. Dann, our Treasurer, \$96.00 at 8 per cent. making a total of \$480.00 with a reserve fund of \$17.00. This we lent to our members at 11 per cent., having decided that the maximum loan to any member at one time to be \$48.00 and that no loan be made for a period exceeding twelve months.

Matters went on smoothly until early 1918, when a letter was received from the Audit Office asking that the books be submitted for audit. Previously, two persons in our district were asked to be good enough to audit our accounts, but these, unfortunately, preferred not to have anything to do with money matters of peasant proprietors, and the Society left the matter in the hands of Mr. Geo. Murray and the Chairman, who could not get through, as the whole state of the books had to be changed. The books were sent to the Audit Office who through the Registrar informed us that the Secretary or Chairman would have to come to Port-of-Spain to follow the reconstruction of the books in the form required by the Auditors. The Secretary being unable to go on account of other duties, the Chairman, although suffering a serious attack of fever decided to go, provided the Society would bear part of his expenses in the sum of \$20.00. As there was no time to have a meeting for sanctioning this, the matter was laid before the Secretary, Trustees and Treasurer, who agreed to support it at the next meeting and on May 9, the Chairman left for Port-of-Spain, where he completed the work with the kind assistance of Mr. Dumoret of the Audit Office, returning two weeks later, reduced by fever to a physical wreck.

Mr. Dann was elected to act as Chairman which position he satisfactorily filled until this month.

Owing to illness which confined me in hospital, I was unable to give any instructions to the Secretary, or any other officers as to the keeping of the books, so these had to stand over until the present time. Consequently, the closing of the books was extended to August 23. This was merely done as it completes a year, but in future balance sheets will be laid before you to June 30 and December 31 of each year.

As you will see from the balance sheet I shall lay before you in due course, the difference between our assets and liabilities is a profit of \$37.53. Of this, not less than 10 per cent. is due to our Reserve fund, and the remainder will assist our working capital until we shall have got sufficient to put to some other useful purpose.

Our cash in hand is \$62.55 and \$6.80 of this has to be deposited in the Government Savings Bank to make up for the amount borrowed in our early days for purchase of office supplies, as our interest was not paid in advance.

Unfortunately our charges have been high but this is due to the unforeseen expenditure of \$20.00 for the Chairman's trip to Port-of-Spain, in connection with the books. We shall always be able to feel that in this direction, we are able to assist any Society that comes after us.

Early this year your Committee discussed the possibility of opening a savings branch, paying dividends on deposits, which may be from 24 cents upwards, and requiring fourteen days notice for withdrawals of amounts exceeding \$25.00. This was laid before you at a subsequent meeting and approved of, subject to the sanction of the Registrar, who, I am glad to report approves of the suggestion in part, *i.e.* he would prefer that a fixed rate of interest be made on deposits; this I hope you will settle to-day.

I would like to offer our thanks to Mr. Dann for coming to our assistance in giving us the use of part of his house as an office free for six months, and consenting to accommodate us here at £2 per year. Also to your outgoing Committee and Officers for their perseverance and co-operation.

So far only one member has failed to keep with his agreement, and has an outstanding debt against him of \$15.20.

From the time of registration, to the writing of this report, ten new members were admitted and one applicant rejected, making a total membership of 27, and although these are not as many as we had hoped for, we are satisfied with a few true ones at a time.

Concluding I must express my regret at the irregular attendance of members both of the Committee and general meetings. All in all, the year past has not been unsuccessful; this Society has been the cause of a much greater production of food in the district than before its advent, and I sincerely hope that this good work will continue and unpunctuality of our members in attending meetings cease.

(Sgd.) F. D. DAVIES,

Chairman.

Adopted at the annual general meeting held in the registered office on August 28, 1918.

PEMBROKE AGRICULTURAL CREDIT SOCIETY.

Statement of Receipts and Payments from May, 1917 to June, 1918.

(Certified as correct by the Hon. Auditor-General).

RECEIPTS.		PAYMENTS.	
	\$ c.		\$ c.
Members Interest on Loans	19 94	Loans to Members	... 620 40
Loans to Society	... 576 00	Loans to Society repaid	... 224 00
Reserve Fund...	.. 24 30	Charges Account	... 20 69
Loans to Members repaid...	288 20	Interest paid on Loans to	
		Society	... 11 08
		In Savings Bank	... 19 20
		Cash in hand	... 4 27
	<u>\$ 908 64</u>		<u>\$ 908 64</u>

Balance Sheet at June 30, 1918.

LIABILITIES.		ASSETS.	
	\$ c.		\$ c.
Loan from Receiver-General	160 00	Loans to Members	... 332 20
Loans from private sources	192 00	Interest due by Members...	45 77
Interest due on Loans	... 22 86	In Savings Bank	... 19 20
Reserve Fund...	... 24 50	Cash in hand	... 4 27
Profit and Loss Account...	2 08		
	<u>\$ 401 44</u>		<u>\$ 401 44</u>

SCARBOROUGH AGRICULTURAL CREDIT SOCIETY.

Report presented to the Annual General Meeting held
August 27, 1918.

On July 19, 1917, the first attempt at forming an Agricultural Credit Society in the Scarborough District was made by our Secretary who received acknowledgment of his intentions from the Registrar on the 27th of the same month by sending 6 copies of the Agricultural Credit Societies Ordinance, and each of the forms required in connection with their working.

Within the month 29 men came forward and signed the articles of Association of the Society which at a General meeting held in Wesley Hall on August 28, 1917, received the name of the Scarborough Agricultural Credit Society.

The officers of the Society were elected on August 28, together with the members of Committee. The Society thus formed applied for registration. The then Acting Commissioner-Warden, and his Committee after two meetings decided that it was impracticable to carry on the registration of the Society without the Registrar who at the time was on furlough. On March 11, 1918, the Registrar wrote:—

"In reply to your letter of February 28, I am arranging to come to "Tobago by boat of 25th instant," and whilst there, to deal with the "matter of the Scarborough Agricultural Credit Society." On April 11 the Registrar wrote to the effect:

"I beg to inform you that I have this day registered the Scarborough Agricultural Credit Society and have forwarded a notice of such registration to the *Royal Gazette* for publication therein."

Being duly registered the original members of the Society decided that the sum of One hundred and fifty pounds (£150) be raised for the present, and that the Royal Bank of Canada be approached and enquired of whether they would be willing to give the Scarborough Credit Society a loan, and what the rate per centum will be, and the time allowed for the repayment of the loan.

The Registrar referring to the Society's application for one hundred and fifty pounds (£150) writes —

"In previous cases the Government has adopted the principle that it should not provide the whole of a Society's capital, and probably in this case would advance the first £50, and a second £50 after you have obtained £50 from private sources."

June 17 brought information that the Board of Management has granted the Scarborough Agricultural Credit Society a loan of Fifty pounds now, and a second loan of £50 when the Society has obtained £50 from private sources; the loan to bear interest at 6 per centum and to be repayable by three successive yearly instalments, the first to be paid at the end of the present year. A voucher payable to the trustees for the sum of £50 has been forwarded to the Commissioner-Warden, and will be given to the Trustees when properly signed.

Here I may state that this particular voucher for some reason or other was never cashed till early in this month.⁽¹⁾ The Royal Bank of Canada came to the help of the Society and gave a loan of Two hundred and forty dollars (\$240) and thereby enabled the Society to loan its members something on July 23. On August 3 the voucher from the Receiver-General was cashed.

The rate of interest payable to the Royal Bank of Canada by the Scarborough Agricultural Credit Society is 8 per cent., while the interest payable to the Agricultural Society on loans to its members is 10 per cent.

No loans were issued to members prior to June 30, 1918.

(Sgd.) A. C. JOHN,
Honorary Secretary.

(1.) The reason was that in the interval the Society changed one of its Trustees and the voucher was made payable to the two original Trustees.

W. G. F.

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SUGAR.

SUGAR CANE EXPERIMENTS 1916-18.

Results of Tests of Varieties.

By JOSEPH DE VERTEUIL, F.I.C., F.C.S.,
Superintendent of Field Experiments.

The canes under report were grown at the Experiment Station, St. Augustine, and consist of plant canes and first ratoons. The plant canes received an application of pen manure at the rate of about 15 tons per acre. No manures were applied to ratoons and all the canes received ordinary estate cultivation.

During the period under review both plant canes and ratoons were attacked by froghoppers and although the attack was not severe the yield of canes and quality of juice were below the average. The following varieties were less severely attacked:—T. 75, T. 202, H. ?, H. 27, H. 227, Badilla, B. 6388, B. 376 and B. 1753.

The results obtained from the plant canes are recorded in Tables I and II; those for the ratoons in Table III, and Table IV gives the average results for plants and ratoons.

Information with regard to the date of planting, and testing of the juice is given at the head of the tables.

The plant canes in Field 10, Valsayn, Table I, were tested in March, April and May when they were 17, 18 and 19 months old respectively. In March none of the canes were ripe and generally the quality of the juice was very poor. When tested a month later, there was a great improvement in the quality of the juice and a still further improvement had taken place when the canes were reaped and tested in May. It will be observed that the following five varieties B. 156, T. 202, B. 347, T. 75 and T. 39 gave a better quality juice in April than in May and these varieties were probably over ripe when tested on May 10. With regard to the two latter, however, the difference is so small that it may be due to experimental error in sampling.

The highest results were obtained from B. 156, followed by T. 202 and B. 208; all the varieties have done better than the Bourbon with the exception of T. 39.

TABLE I.—PLANT CANES.—Continued.

CANE.	Area under culti- vation.	JUICE.						PER ACRE.		
		Per cent. extracted.	Specific gravity.	Brix.	Percentage of			Sugar per gallon.	Cans.	Juice.
					Sucrose.	Glucose.	Non- sugar.			
								Quotient of purity.	Tons.	Gals.
								Lb.	Tons.	Gals.
D. 109	...	66.9 { 5,940 (a) (b) (c) ...}	1.0337 1.0317 1.0639	13.7 15.1 15.6	9.97 11.53 12.00	2.58 2.45 2.18	1.16 1.12 1.42	72.8 76.3 76.9	45.37	6,534
H. 227	...	66.6 { 5,902 (a) (b) (c) ...}	1.0591 1.0691 1.0717	14.5 16.8 17.1	11.46 13.98 14.92	1.75 1.63 1.37	1.29 1.23 1.11	79.0 83.2 85.7	32.11	4,678
Ladilla	..	64.9 { 7,360 (a) (b) (c) ...}	1.0691 1.0828 1.0886	16.8 19.9 21.2	14.23 17.75 19.62	1.81 1.63 0.89	0.76 0.52 0.60	84.7 89.2 92.5	26.89	3,260
B. 4934	...	63.1 { 10,071 (a) (b) (c) ...}	1.0566 1.0630 1.0744	13.9 15.4 18.0	11.39 13.18 16.34	1.53 1.32 0.94	0.93 0.90 0.72	81.9 85.6 90.8	28.28	3,773
B.N.H. 02 (1)	...	66.0 { 5,319 (a) (b) (c) ...}	1.0506 1.0617 1.0691	12.5 15.1 16.8	9.07 12.32 14.81	2.04 1.81 1.04	1.39 0.97 0.95	72.6 81.5 83.1	23.05	4,070
T. 75	...	69.0 { 5,670 (a) (b) (c) ...}	1.0566 1.0691 1.0665	13.9 16.8 16.2	9.96 13.40 13.04	2.45 2.24 2.18	1.09 1.16 0.98	71.6 79.8 80.5	20.88	4,227
B. 376	...	67.6 { 13,137 (a) (b) (c) ...}	1.0574 1.0617 1.0647	14.1 15.1 15.8	11.48 12.66 13.00	1.88 1.75 1.65	0.74 0.69 0.55	81.4 83.8 86.1	20.14	4,095
B. 6450	..	70.1 { 8,944 (a) (b) (c) ...}	1.0566 1.0709 1.0733	13.9 17.2 18.2	10.65 14.89 16.08	2.04 1.81 1.14	1.21 0.60 0.98	70.6 86.6 88.3	24.11	3,420

TABLE I.—PLANT CANES.—Continued.

CANE.	Area under culti- vation.	JUICE.						PER ACRE.													
		Per cent. extracted.	Specific gravity.	Brix.	Percentage of		Quotient of purity.	Sugarcane per gallon.	Cane.	Juice.	Sugarcane in juice.										
					Sugarcane.	Glucose.						Non- sugar.									
									Lb.	Tons.	Gals.	Tons.									
B. 6388	...	65.9 67.8 68.1	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)									
													13.9	10.35	2.33	1.22	74.5	1.093	23.32	3,598	2.64
													16.0	12.91	2.45	0.64	80.7	1.376			
B. 3922	...	65.7 68.3 67.7	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)									
													13.8	11.00	1.96	0.84	79.7	1.162	24.17	3,407	2.60
													16.3	13.62	1.81	0.87	83.5	1.453			
B.N.H. 02 (5)	...	61.2 64.7 64.9	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)									
													15.3	12.45	1.88	0.97	81.4	1.323	26.73	3,627	2.52
													16.4	13.67	1.81	0.92	83.3	1.369			
H. ?	...	63.6 62.8 64.4	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)									
													16.4	14.50	1.14	0.76	88.4	1.548	21.76	2,902	2.45
													17.7	15.20	1.63	0.78	86.3	1.641			
B. 6385	...	64.4 64.7 65.8	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)									
													14.7	12.04	1.58	1.08	81.9	1.276	20.36	2,849	2.31
													18.1	16.09	1.14	0.87	88.9	1.729			
H. 27	...	68.3 63.3 65.7	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)									
													13.6	9.72	2.72	1.16	71.5	1.026	24.24	3,330	2.25
													14.6	10.28	2.72	1.60	70.4	1.069			
Bourbon	..	70.2 69.8 69.9	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)									
													14.9	11.74	2.04	1.12	78.8	1.245	20.12	2,936	2.16
													16.7	13.80	2.04	0.86	82.6	1.475			
T. 39	...	68.0 67.9 67.1	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)	{ (a) (b) (c)									
													16.8	14.28	1.58	0.94	85.0	1.527	19.70	2,786	2.15
													18.2	16.08	1.36	0.76	88.3	1.729			

RECENT INTRODUCTIONS.

The results of the more recently introduced varieties are recorded in Table II. None of these have given very promising results. Better field returns would have been obtained from L. 511 but on two occasions plants were cut out from this plot.

TABLE II.—PLANT CANES.

CANE.	Area under culti- vation.	JUICE.						PER ACRE.					
		Per cent. extracted.	Specific gravity.	Brix.	Percentage of			Quotient of purity.	Sucrose per gallon.	Canes.	Juice.	Sucrose in Juice.	
					Sucrose.	Glucose.	Non- Sugar.						
...	...	Sq. ft.	65.5	1.0460	16.1	13.29	1.92	0.89	82.5	1.417	37.02	5.178	3.27
M. 1237	...	3,300	70.6	1.0596	14.6	10.87	2.53	1.20	74.4	1.152	35.55	5.306	2.73
M.P. 56	...	3,680	68.4	1.0487	16.7	14.83	1.45	0.92	85.8	1.531	27.73	3.975	2.72
Striped	...	6,980	61.9	1.0726	17.6	14.82	1.71	1.57	81.4	1.536	27.00	3.460	2.39
White Tanna	...	3,030	62.6	1.0614	21.8	20.28	0.54	0.98	93.0	2.213	13.61	1.749	1.73
L. 511	...	2,800	62.6	1.0614	21.8	20.28	0.54	0.98	93.0	2.213	13.61	1.749	1.73
M. 90 ^{ns}	...	6,000	64.9	1.0630	15.4	12.70	1.40	1.30	82.5	1.350	19.30	2.638	1.59
B. 7482	...	3,030	66.6	1.0739	17.9	15.64	1.41	0.95	86.8	1.668	10.80	1.500	1.12
M.—Martinica.													
L.—Louisiana.													

RATOON CANES.

The results from the first ratoons in Field 1, St. Augustine, are given in Table III. The canes from this plot were reaped, as plant canes, towards the end of March 1917, being 17 to 18 months old; as first ratoons they were cut at the end of March and beginning of April and were then 12 to 12½ months of age. Although these canes were the most severely hit by the frognopper, the tonnage of canes reaped per acre was good but on the other hand, with the exception of B. 6885 and the Badilla, the juice was of poor quality. The best results were obtained from H. ? , B. 6885, L. 208 and B. 947; twenty varieties have done better than the Bourbon and thirteen have given lower results.

TABLE III.—FIRST RATOONS.—Continued.

Date planted Plants raised and tested		Sep., 1915—Field No. 1, St. Augustine Estate. ... March 1917—17-18 months old.	Ratoons reaped and tested Rainfall		...		March-April 1918—12-12½ months old. ... April 1917 to March 1918—62-54 inches.					
CANE.			JUICE.				PER ACRE.					
	Area under culti- vation.	Per cent. extracted.	Specific gravity.	Brix.	Percentage of			Quotient of purity.	Sugar per gallon.	Cane.	Juice.	Sugar in juice.
					Sucrose.	Glucose.	Non- sugar.					
D. 109	...	63.5	1.0665	16.2	11.72	2.45	2.03	72.3	1.250	Tons. 2,257	Gals. 3,010	Tons. 1.08
D. 504	...	63.5	1.0722	17.5	14.18	2.06	1.26	81.0	1.520	18.23	2,418	1.64
B. 6388	...	66.6	1.0536	13.2	9.20	2.58	1.42	69.7	0.969	25.73	3,643	1.57
B. 7169	...	66.4	1.0574	14.1	9.85	2.45	1.80	69.8	1.041	23.18	3,261	1.51
B. 156	...	61.8	1.0630	15.4	12.15	2.45	0.80	78.9	1.291	20.10	2,617	1.51
D. 2468	...	62.7	1.0748	18.1	14.78	2.72	0.60	81.6	1.588	16.06	2,099	1.49
B. 4634	...	62.2	1.0643	15.7	13.56	1.36	0.78	86.3	1.443	17.48	2,288	1.47
D. 366	...	64.8	1.0775	18.7	16.05	1.40	1.25	85.8	1.729	11.15	1,502	1.16
B. 3390	...	61.9	1.0578	14.2	9.75	2.88	1.57	68.7	1.031	18.98	2,488	1.14
B. 16892	...	67.5	1.0617	15.1	10.75	2.58	1.77	71.2	1.141	14.74	2,099	1.07
B. 3412	...	63.8	1.0464	11.5	6.17	2.88	2.45	53.6	0.646	25.73	3,514	1.01
D. 115	...	61.5	1.0722	17.5	14.24	2.24	1.02	81.4	1.527	11.51	1,479	1.01

AVERAGE RESULT PLANT CANES AND RATOONS.

The average results of plant canes and first ratoons from Field 1, St. Augustine, are given in table IV. The best results were obtained from H. 227, B. 208, B. 6835, H. ?, B. 147, B. 156, Badilla, B. 3922, B. 347, D. 145 B. 6450, T. 75, and B. 6808. All of these varieties show an average of over 3 tons of sucrose in the juice per acre for the two years. Twenty-two varieties have done better than the Bourbon and twelve have given lower results.

TABLE IV.—AVERAGE RESULTS OF PLANT CANES AND FIRST RATOONS.

CANE.	SUCROSE IN JUICE—TONS PER ACRE.		
	Plant canes 17 to 18 months old.	1st Ratoons 12 to 12½ months old.	Average for 2 years.
H. 227 ...	4.63	2.58	3.60
B. 208 ...	4.30	2.79	3.54
B. 6835 ..	4.08	2.82	3.45
H. ? ..	3.77	3.02	3.39
B. 147 ..	4.07	2.51	3.29
B. 156 ...	5.06	1.51	3.28
Badilla ...	4.03	2.48	3.25
B. 3922 ...	4.08	2.28	3.18
B. 347 ...	3.56	2.5	3.15
D. 145 ...	4.62	1.68	3.15
B. 6450 ...	3.96	2.27	3.11
T. 75 ...	3.93	2.18	3.05
B. 6808 ...	4.14	1.92	3.03
D. 504 ..	4.08	1.64	2.86
D. 109 ...	3.97	1.68	2.82
T. 39 ...	3.48	2.07	2.77
H. 146 ...	3.84	1.70	2.77
D. 116 ...	3.64	1.87	2.75
B. 3390 ...	4.32	1.14	2.73
B. 1753 ..	3.30	2.13	2.71
D. 3956 ...	3.23	2.11	2.67
H. 27 ..	3.17	1.96	2.56
Bourbon ...	3.25	1.70	2.47
D. 366 ...	3.74	1.16	2.45
B. 7169 ...	3.37	1.51	2.44
T. 202 ..	2.42	2.31	2.36
B. 4578 ...	2.99	1.74	2.36
D. 2468 ...	3.16	1.49	2.32
B. 4934 ...	3.14	1.47	2.30
D. 115 ...	3.53	1.01	2.29
B. 376 ..	2.77	1.76	2.26
B. 3412 ...	3.52	1.01	2.26
Ba. 6032 ...	2.48	1.94	2.21
B. 16832 ..	3.29	1.07	2.18
B. 6388 ..	2.31	1.57	1.94

PLANT DISEASES AND PESTS.

NOTES ON SOME TRINIDAD THIRPS OF ECONOMIC IMPORTANCE.

By C. B. WILLIAMS, M.A., F.E.S.

The thrips are a group of minute insects, the largest of which is barely one-third of an inch long while the more usual kinds seen in this island are little more than a twelfth of an inch. They are brown or yellow in colour, narrow bodied and, in the adult stage, usually with two pairs of feather-like wings which lie along the body when at rest and are inconspicuous except when banded with dark and light. The younger stages are wingless, usually yellow in colour with occasional red markings or banded with red and white.

The thrips that come to the notice of the Agriculturist are generally those which feed upon plant juices and destroy the leaves and fruit of cultivated plants. Some of these make up in numbers what they lack in size and cause considerable damage. The best known example in this island is the *Cacao Thrips* or Red-banded Thrips (*Selenothrips rubrocinctus*) which is one of the most serious pests of Cacao in the West Indies. Although the greater number of thrips are plant feeders, there are others which are predaceous and might be classed as useful insects. Attention will be drawn below to two thrips common in this island both of which are predators and are known to feed occasionally, at least, on the young of the cacao thrips. Another thrips (*Haplothrips* sp.) was found in Demerara and Panama to feed on the eggs of froghoppers; while others in different parts of the world have been recorded as feeding on mites, "red-spiders," and scale insects. One Trinidad thrips has even been seen to suck blood.

Between seventy and eighty different species of thrips have been collected in Trinidad, chiefly by Mr. Urich and myself in the last three years and these are being studied as rapidly as present circumstances permit. The greater number, however, are of no immediate economic importance and the notes below are confined to those which are known to be either definitely injurious, definitely beneficial, or liable to be confused with the above.

Frankliniothrips vespiformis, Crawford (Fig. 1) (1).

This thrips is an active long-legged, somewhat large ant-like insect, with banded black and white wings, and a white band at the base of the abdomen. It is largely, if not entirely, predaceous and is found on the leaves of various plants where it feeds on smaller insects and their young. It has been seen to feed on the young of the cacao thrips. The prey is pierced with its pointed beak, the juices sucked out and the empty skin discarded.

It is not uncommon on leaves of cacao among the adults and nymphs of the cacao thrips and may be distinguished from these by its larger size, active ant-like appearance and banded wings.

(1.) Fig. 1 is drawn by Mr. W. Butlin, the rest by the author.

The nymph (young) of this thrips is also predaceous and may be found on leaves infested with cacao thrips. It is bright vermilion in colour with three pale yellowish bands near the tip of the abdomen, and should not be confused with the red banded nymph of the cacao thrips which is more sluggish and has a single narrow red band round the middle of the abdomen.

It has been found so far on the leaves of guava (*Psidium guajava*), sweet potato (*Ipomoea batatas*), cacao (*Theobroma cacao*), bamboo (*Bambusa vulgaris*), *Lantana camara*, and on grass and various low shrubs.

It is generally common throughout the West Indies and Central America.

Franklinothrips tenuicornis, Hood.

This thrips is, in the adult stage, extremely similar to the above. The two can be distinguished most readily by the fact that the antennæ of *F. tenuicornis* are more slender and have the basal four segments yellow, while in *F. vespiformis* the antennæ are a little stouter and have only the three basal joints yellow.

The nymph of *F. tenuicornis* is yellow with a broad vermilion band on the abdomen from segments one to six and a narrow band near the tip of segment nine. This colouration distinguishes it immediately from the nymphs of the previous species and of the cacao thrips.

In habits it is identical with *F. vespiformis* so far as is known but it is rarer and more restricted in range.

It has been found in Trinidad on leaves of pois doux (*Inga* spp.), cacao, *Hibiscus rosa sinensis*, and morning glory (*Ipomoea* sp.)

Abroad it is only known from Panama.

Heliothrips hæmorrhoidalis, Bouche.

This thrips is closely related to the cacao thrips both in structure and in habits and the two species may be found living together on the same leaf. *H. hæmorrhoidalis* may be distinguished by the dark reddish brown body, pale wings and yellow legs. It is one of the most widely distributed thrips in the world, being known from every continent. In Europe and North America it is a serious pest in greenhouses and is known as the "greenhouse thrips."

In Trinidad it is most frequent on leaves of cacao and coffee, but is never common enough to be a serious pest. I have also seen it damaging the leaves of cotton. It is found only on leaves and never in the flowers of the cacao or any other plant.

The nymph of this thrips is without the red band of the cacao thrips.

It has been found on the leaves of cacao, guava, cotton (*Gossypium* sp.), camphor (*Cinnamomum camphora*), Pomme de liane (*Passiflora laurifolia*) Coffee (*Coffea arabica*), Eucalyptus in Australia, fiddle-wood (*Ocotea fruticosa*), kola (*Cola acuminata*) in St. Vincent, date palm (*Phoenix dactylifera*) in Barbados, mango (*Mangifera indica*), coconut (*Cocos nucifera*), hog plum (*Spondias lutea*), and in Europe on ferns in greenhouses.

Selenothrips [*Heliothrips*] *rubrocinctus* (Giard) (Fig. 2).

The Cacao thrips or the Red-banded thrips. This is the only seriously injurious thrips in the West Indies. Full particulars of its life-history are given by Mr. F. W. Ulrich, in a *Circular* of the Board of Agriculture (1911). It is entirely a leaf inhabiting insect and is only found by accident and very rarely in flowers. The thrips in the flowers of the bois immortelle (*Erythrina*) used as shade for the Cacao, and even those found occasionally in the flowers of the cacao are both quite distinct from the cacao thrips.

No efficient natural enemies are known at present. A fungus (*Sporotrichum globulosum*) has been recorded as attacking it in St. Vincent (Nowell, *Agricultural News*, Barbados XV, 1916. 110) and I found in Panama a distinct but somewhat similar fungus destroying both young and adults. In Guadeloupe an ant (*Wasmannia auropunctata*. Roger) was seen carrying off young cacao thrips in its jaws and the larvæ are also destroyed by the two predaceous species of *Franklini*-*thrips*, as mentioned above and by small predaceous bugs (*Reduviidae*).

It has been found on leaves of Cacao, guava, mango, camphor, pois doux (*Inga* spp.), Live Oak (*Quercus virginiana*) in Florida, croton (*Codiaeum variegatum*), cashew (*Anacardium occidentale*), kola, grape vine (*Vitis vinifera*), "almond" (*Terminalia catappa*), pomme rose (*Eugenia jambos*), *Sponia micrantha*.

It is known from practically all the West Indian Islands, from United States of America, British Guiana, Surinam, Panama, Costa Rica, Brazil and Mauritius.

Mr. Rorer in a recent visit to the Cacao districts of Ecuador did not see a single specimen during nearly two months.

Corynothrips stenopterus, Williams (Fig. 3).

The Cassava thrips. A medium sized yellowish green and brown thrips found commonly on the undersides of the leaves of cassava (*Manihot utilissima*) and rarely on papaya (*Carica Papaya*). When common it causes the surface, particularly near the ribs, to be discoloured in irregular brownish patches and the leaf may be curled or distorted.

The eggs are laid embedded in the mid-rib of the leaf on the underside and all stages are passed on the leaf. The larva and pre-pupa are semitransparent yellowish green, the pupa is paler with a reddish head, and shortly before emergence with the brown dorsal markings of the adult.

It has been found in Trinidad wherever cassava is grown and also in Barbados, Grenada, St. Vincent, Tobago, British Guiana, Panama, and Costa Rica.

Frankliniella insularis (Franklin).

A very abundant small black thrips found in flowers of all kinds, but particularly in those of the Leguminosae. It is generally common in the flowers of the bois immortelle (*Erythrina glauca* and *E. micropteryx*) and is frequently confused with the cacao thrips. It may be immediately distinguished by the white band at the base of the wings, and by its narrower form and more active movements. The eggs are laid

embedded in the petals and other parts of the flower of legumes (e.g. Lima beans) and the yellow larvæ live chiefly on the flowers and young seed pods. In Europe a closely allied species descends into the ground to pupate, but nothing is yet known of the habits of this species.

It is occasionally sufficiently abundant in flowers of legumes to destroy the flowers and pods and in the cultivated varieties may be a source of loss, but in the cacao estates where it is most abundant it is quite harmless.

It has been found in the flowers of Lima bean (*Phaseolus* sp.) *Cassia*, pois doux (*Inga* spp.), *Lantana* spp., white wood (*Tecoma leucowylon*), bois immortelle (*Erythrina* spp.), cannon ball tree (*Couroupita guianensis*), Hibiscus, rose (*Rosa*), pigeon peas (*Cajanus indicus*), papaya, flamboyant (*Poinciana regia*), bonaviste (*Dolichos* sp.), tobacco (*Nicotianum*), sweet potato (*Ipomoea batatas*), red pepper (*Capsicum* sp.), arrowroot (*Maranta* sp.), yam (*Dioscorea* spp.) and on Guinea grass (*Panicum maximum*) the last probably accidental. The species occurs throughout Central America and the West Indies.

Physothrips xanthius, Williams (Fig. 4).

The Yellow Orchid Thrips. This is a small yellow thrips with black eyes and greyish wings which is found commonly on orchids, particularly *Cattleya*, in some localities and frequently does quite severe damage to the leaves. Both young and adults are found together on the leaves. It may be an introduced species as up to the present it has not been found on orchids growing wild.

Sedulothrips insolens, Bagnall (Fig. 5).

This rather large thrips is often seen in cacao estates on the trunks of dead or dying trees. It is shining black in colour with red eyes.

It is extremely active and runs about rapidly in the direct sunshine. The young, which are banded red and white, are common in similar situations and walk slowly, swinging the body from side to side.

This species, which is sometimes thought to be injurious, is quite harmless and only appears after the death of the branch on which it lives. Little is known of its habits, but it appears to feed on small insects and possibly also on fungi and their spores.

It is not at present known outside Trinidad.

REFERENCES TO FIGURES.

Fig. 1. *Frankliniothrips vespiformis*.

Fig. 2. *Seleniothrips rubrocinctus*.

Fig. 3. *Corynothrips stenopterus*.

Fig. 4. *Physothrips xanthius*.

Fig. 5. *Sedulothrips insolens*.

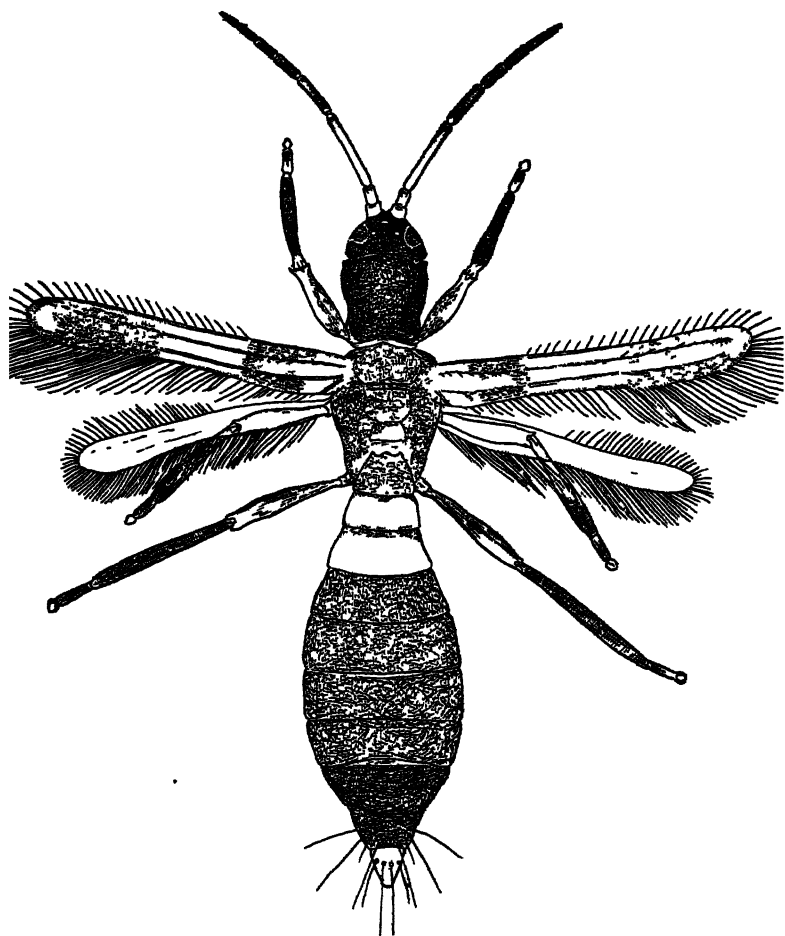


Fig. 1.

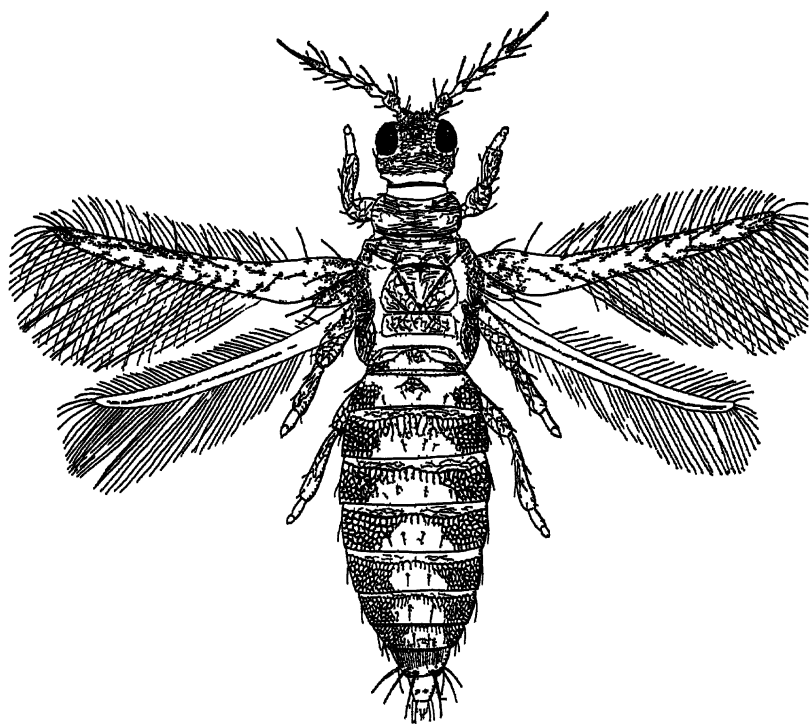


Fig. 2.

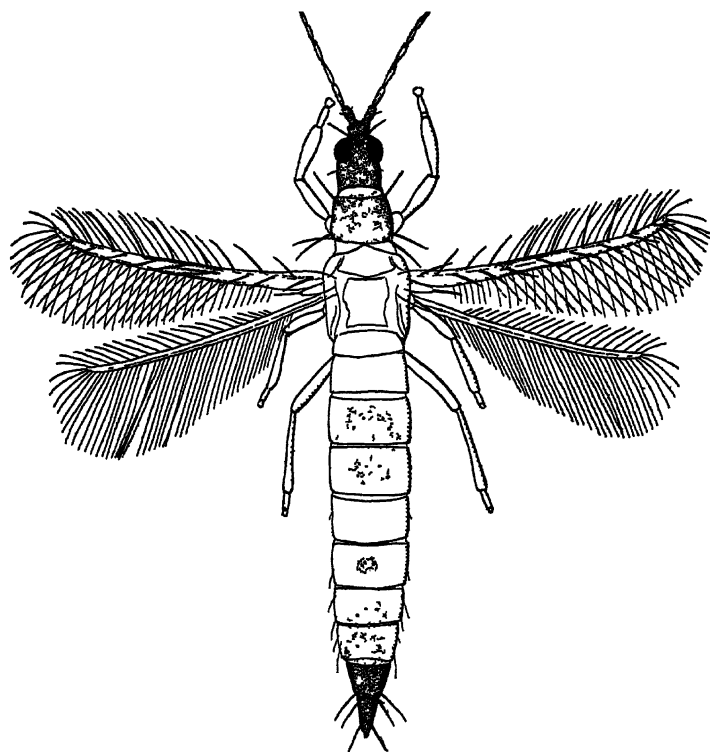
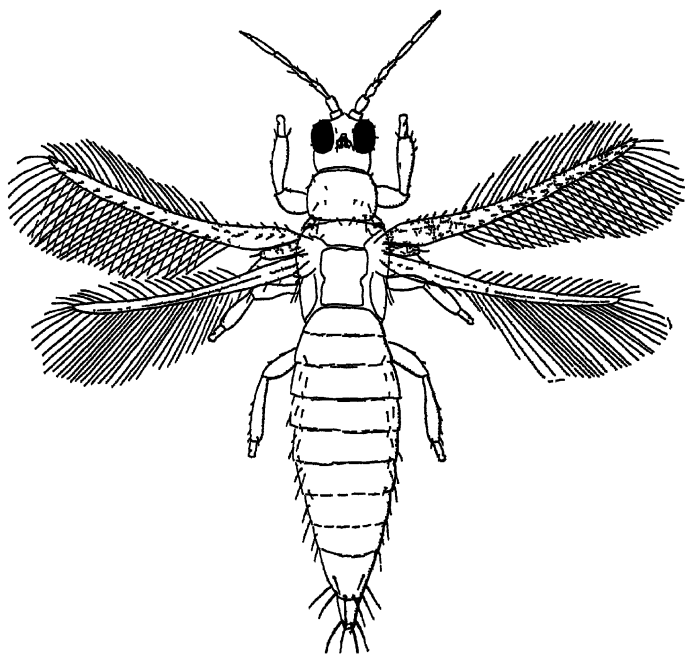


Fig. 3.



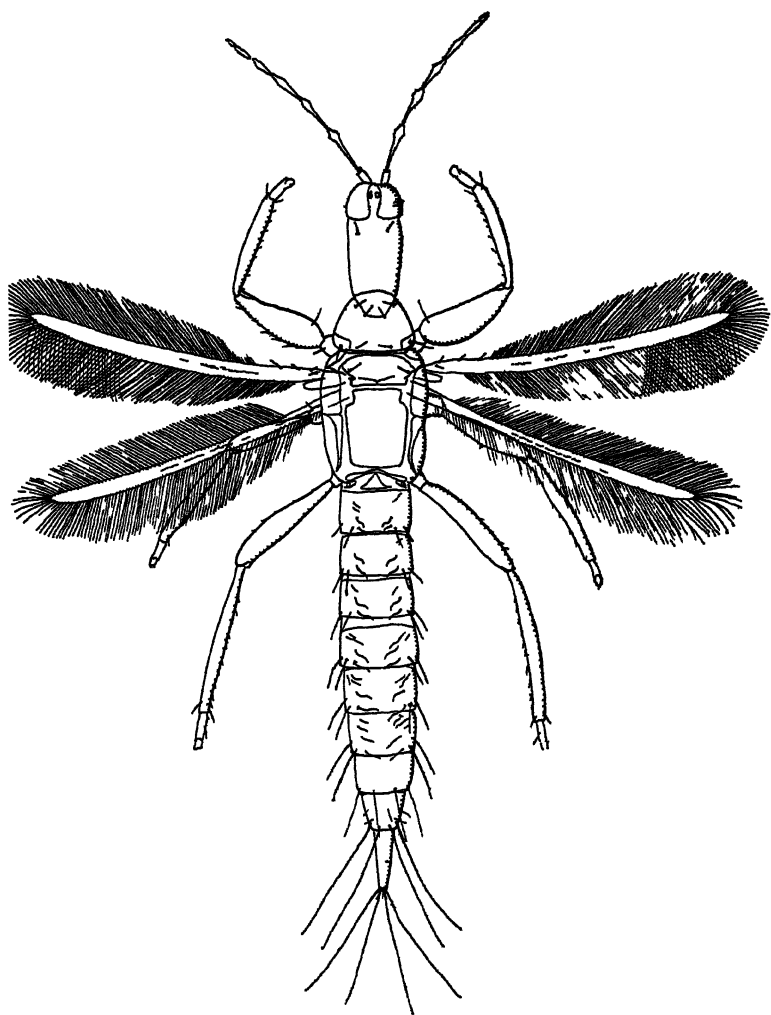


Fig. 5.

BOTANICAL.

AQUATIC PLANTS AT ST. CLAIR EXPERIMENT STATION.

For some years the Royal Botanic Gardens and the St. Clair Experiment Station have had no very suitable place for growing aquatic plants there being only the small fountain near the Wallaba tree in front of Government House and such accommodation as the concrete cisterns under the stand pipes in the nursery offered.

In 1916 a spot in the Trial Grounds at St. Clair south-west of the office was chosen as the site of a new pond, and soil being wanted at that time for filling holes in St. Clair Square, advantage was taken to dig out the soil ready for laying the foundation of the pond.

The pond was built in 1917 after the style of one in the Royal Botanic Gardens, Kew, being especially designed for growing the *Victoria regia*. It was built chiefly by garden labour in spare time, the only other labour employed being a mason to plaster it. The dimensions of the pond are as follows; sides 28 feet by 28 feet, and 2 feet 6 inches deep with walls $7\frac{1}{2}$ inches in thickness. Triangular corner pockets have been made for growing shallow-watered aquatics, and a bricked portion in the centre 4 feet by 4 feet built to within 6 inches of the water's surface in which to grow the *Victoria regia*. In the corner pockets and the centre portion, spaces have been left to allow of free circulation of the water.

Water was laid on from the main and an outlet made in the form of a pipe, the top of which is about $\frac{1}{2}$ an inch below the level of the sides. This pipe is made in such a manner that it can be used as an overflow or withdrawn when it is desired to empty the pond. A quantity of "millions" fish which have since increased rapidly were put into the pond to prevent mosquitos breeding. A few gold fish were also added.

The corner pockets and the centre portion had a layer of stones placed at the bottom, and were then filled up with a mixture of two parts sandy loam and one part cow-manure with the addition of a little charcoal.

VICTORIA REGIA.

Seeds of the *Victoria regia* were kindly presented by Mrs R. V. Butt, who brought them with her from Demerara, but owing to their not being kept moist they failed to germinate.

Another lot of seeds was obtained from the Department of Agriculture British Guiana, on February 12, 1918. They were carefully packed in moist mud; only two seeds germinated, the first on April 11, two months after the sowing of the seed. At Kew in the Tropical Houses, I have known *Victoria regia* to germinate in 10 days, but the more usual period is 3 to 4 weeks.

The first of the two seedlings raised was grown in a pot for several weeks and then transferred to the centre of the tank. Rapid growth was made and the largest leaves measured 4 feet 3 inches in diameter. This however is somewhat small for the *Victoria*, as leaves have been produced under glass in Europe seven feet across. The first flower appeared on August 6, about 4 months after germination. Flowers have since been produced every few days.

It is an interesting sight to watch in the evening during the last hour of daylight one of the flowers open; as what is practically a bud with only a little white of the petals gleaming between the spaces of the calyx is an hour later a creamy white wide open flower. The movement of the flower in opening is so rapid as to be perceptible. About noon next day the flower closes and opens again three or four hours before dark, the colour then being decidedly pink. By next morning the flower has faded and begins to sink below the surface of the water.

The *Victoria regia* is a gross feeder and constant additions of manure have to be made to the mud in which it is growing to keep the plant in proper condition.

The following interesting note on its introduction and culture in Europe, is to be found in the *Royal Botanic Gardens Kew* by W. J. Bean:—

"In 1837 Dr. Lindley obtained permission from Queen Victoria (then newly ascended to the throne) to name this the Queen of aquatics in her honour. It was henceforth called *Victoria regia*." Nine years later (1846) seeds were taken to England by Mr. Bridge, but although the seeds germinated the young plants did not survive the winter.

In 1849 seeds were again successfully introduced, and the young plants flowered for the first time in England the same year.

Victoria regia is now grown at Kew as an annual, seeds being sown in March each year. If sown earlier and germination takes place the plants make but little growth till they get the April sun upon them.

It may be also necessary in the restricted area afforded by our Lily pond in St. Clair, to treat it as an annual, that is to say clear the plant out periodically and re-new both soil and plant.

NELUMBIUM SPECIOSUM.

Nelumbium speciosum one of the Lotus Lilies now well established in the small tank in the front garden fills one of the triangular corner pockets. It was raised from seed received from Grenada on September 28, 1916, and produced the first flower on May 1, 1917, 7 months after sowing.

This plant is one of the most handsome aquatics with its round peltate leaves borne on upright petioles 3 to 4 feet high, and the long rhizomes spreading out over the water's surface which bear floating leaves. After a shower of rain it is very pretty to watch the water drops which are caught in the leaves, moving about like particles of mercury as the leaves are swayed with the breeze. When immersed the leaves assume a lovely silvery appearance. The flowers are large, rose coloured and sweetly scented.

Nelumbium seeds were introduced into the gardens some years ago, but the young plants failed to get beyond the seedling stage through being grown in stagnant water.

EICHHORNEA.

The genus *Eichhornea* is represented at present by two species, *E. crassipes* (*E. speciosa*) and *E. paniculata* (*E. Martiana*.)

E. speciosa the Water Hyacinth is quite a feature of the pond at practically all times with its beautiful many-flowered racemes of Lilac-blue flowers. The plant grows from 1 to 1½ feet in height and floats on the water, the roots attaching themselves lightly in the mud.

The buoyancy of the plant is due to the inflation of the basal portion of the leaf-stalks. When growing thickly together the swollen portion is not produced, but the petiole becomes elongated. The original plants were obtained from Cedros where it grows in the ponds in great profusion, whether introduced to that district or not I am unable to say. Griesbach does not record the plant.

E. paniculata (E. Martiana) a South American plant and recorded by Griesbach from Jamaica was obtained quite by chance. The *Victoria regia* seed as above stated was sent from Demerara in mud. Before the *Victoria* germinated a seedling appeared which was grown on till it reached the flowering stage when it turned out to be a new plant to the collections *E. paniculata*.

This plant grows 2 to 8 feet high producing a compound spike of many flowers some of which open each day for a considerable time but fade towards afternoon. In the morning it is bright and showy. The flowers are small two-lipped, the lower lip having three purple segments and the upper also three of the same colour, the centre one being much whiter with two greenish yellow lobes.

The radical leaves are cordate, acuminate and entire, being borne on long petioles.

NYMPHAEAS.

A few *Nymphaeas* planted in reinforced concrete pots and cement barrels fill up a few odd spaces, but room for these is necessarily limited. The following four kinds have been received from the Botanic Gardens St. Vincent.

Nymphaea St. Vincent (rich crimson). *N. hybrida* (pink). *N. lotus dentata* (white yellow centre). *N. tuberosa* var. *rosea*.

Two others, one with a blue medium-sized flower and one producing a tiny blue flower, I brought over from Tobago.

OTHER PLANTS.

Pistia Stratiotes "Water Lettuce" a floating stemless plant forming a rosette of leaves and long feathery roots, was presented to the gardens by Mrs. Date of San Fernando. The plants send out runners, on the ends of which the little plants are formed. It is recorded by Griesbach from Antigua and as being common in Jamaica.

Limnocharis Humboldtii = *Hydrocleys Commersoni*, a Brazilian plant was also presented to the gardens by Mrs. Date. This plant known as the Water Poppy makes a gay show up till midday with its bright yellow poppy like flowers borne on petioles a few inches in length. The plant like many aquatics is a rapid grower and will quickly grow over a large portion of the pond if it is not kept in check.

Acrostichum aureum an aquatic fern very common in the South of Trinidad is represented by a few plants.

There are many more aquatics in the Colony, some of which as far as space allows it is hoped to add to the collection as soon as opportunity permits.

SOLANUM MACRANTHUM.

One of the most conspicuous objects in the Trial Ground of the St. Clair Experiment Station for many months past has been a tree of *Solanum macranthum*, seeds of which were received from the Horticultural Section of the Egyptian Ministry of Agriculture on August 18, 1916.

The seedlings were raised in boxes in the nursery, and transplanted when a few weeks old into a bed adjoining the Water Lily tank. Growth was then so rapid that in a short time all except one had to be removed to allow room for growth, and now at the age of two years and one month it is 30 feet high with a spread of branches of equal measurement.

The plant commenced to flower when but a few months old, and has never been without flowers since, although at certain times they are more abundant than at others. The flowers are about three inches in diameter and make a magnificent show as flowers of several shades are carried by the plant at the same time. This is due to the fact that the corolla on first opening is of a rich, bluish violet colour, changing when a day old to a paler blue, and later fading to a bluish white. A curious fact to which Sir N. Lamont has drawn attention is that the flowers become larger with age, the deep coloured one day old flowers being much smaller than those of two or three days. The anthers are yellow, united in a column about half-an-inch or so in length and very conspicuous.

The main trunk and branches, as well as the petioles and main ribs of the leaves are armed with strong, sharp spines. The large dark green, deeply cut leaves add to the beauty of the tree. The fruit is about the size of a golf ball containing a large number of small seeds.

Macmillan in *A Handbook of Tropical Gardening and Planting* describes it as "A medium sized, quick-growing and soft wooded tree of Brazil, reaching a height of 40 to 50 feet. Introduced into Ceylon in 1844." He further adds that "This is the only species of the Potato-order that grows into a tree form."

Owing to the rapidity and strength of the growth of *Solanum macranthum* it occurred to me that it may be worth experimenting with as a stock on which to bud the Melongene (*Solanum melongena*) and seedlings were raised with this object in view on which buds have been inserted. At the time of writing the buds have made good growth, but it is too early as yet to say definitely whether it will prove useful as a stock for the Melongene. It may prove too strong.

Solanum macranthum as a decorative plant is meeting with great admiration in Trinidad and the first batch of seedlings raised have already been disposed of to numerous people. Owing to the prolific way however in which it produces seed and the easy manner in which seedlings can be raised, there is no trouble in getting a stock of plants. One gentleman has decided on planting an avenue of it at Erin. Several plants are now established in various parts of the Royal Botanic Gardens where it is hoped they will make a good show during the next few years. Plants of this species are probably short lived.

S. macranthum is figured in the *Botanical Magazine*, T 4,138, but as the volume is not in the Garden's library I am unable to compare our tree with it.

In the *Annual Report* of the Superintendent of Agriculture, St. Vincent 1908-09 Mr. Sands says "*Solanum robustum*, seeds of which were received last year from Uganda flowered. It promises to be a most useful decorative plant. The flowers resemble those of *S. Wendlandii*, although they are of a somewhat darker shade."

A plant brought from St. Vincent by Sir Norman Lamont, in 1912 under this name flowers freely at Palmiste. It appears to be the same as the plant we have under the name of *S. macranthum*, which I think is correctly named. The two descriptions (Nicholson's and Bailey's) of *S. robustum* state that it is a plant growing from 2 to 5 feet in height and having a white corolla. This is certainly not a description of the plant growing at Palmiste which is therefore more probably *S. macranthum* especially as Macmillan says this latter is the only species of *Solanum* of an arboreus type.

If such is the case Sir Norman Lamont, is to be credited as being the first on record to introduce *S. macranthum* into Trinidad.

R. O. WILLIAMS.

FORESTRY.

PERMITS FOR REMOVAL OF TIMBER.

In the previous issue of this *Bulletin* (XVII. 1918, 94) the rules regarding permits for the removal of timber were given. It was not mentioned however that these rules only refer to the timber of six kinds of trees namely Cedar, Cyp, Poui, Balsam, Balata and Locust.

The following notice issued by the Conservator of Forests gives additional information and specifies the Proclaimed Districts. As they will also be useful for reference the form of license for extracting Balata and the Forests Ordinance, 1915 are also published.

NOTICE.

Special attention is drawn to Proclamation 88 of 1917 dated 1st November, 1917 which brings into force the provision of Section 7 of the "Forests Ordinance" No. 42 of 1915, with regard to the conveying or moving of timber of the species mentioned in the second schedule of the Ordinance, viz :

CEDAR.	POUI.	BALATA.
CYP.	BALSAM.	LOCUST.

2. The effect of the Proclamation is to make it an *offence* punishable by a fine of £20 or in default of payment, to imprisonment with or without hard labour for a term not exceeding one month, to *convey or move* any timber of the above-mentioned species along any public road, or by railway or water except under a written permit from an officer authorised to issue the same, within the Ward Unions of Manzanilla, Naparima, Arima, Tacarigua, Chaguanas, Savana Grande, Oropuche and Mayaro and within the Wards of Montserrat and Tobago.

3. His Excellency the Governor has authorised the Wardens of the proclaimed districts and the Ward Officers of Moruga and Poole to issue the necessary permits.

4. The permit must be obtained by the owner of the timber before he *conveys or moves it* and must accompany the timber in transit.

5. No fee is payable for the permit, which will be issued by the authorised officer when he is satisfied that the timber to be conveyed or moved is *bonâ fide* private property, and has come from private land with the consent of the owner of such land.

C. S. ROGERS,
Conservator of Forests.

Forest Office,
February 18, 1918.

BALATA LICENSE.

GOVERNMENT HOUSE,
September 15, 1916.

It is hereby notified for general information that in exercise of the powers conferred by Section 4 of the Forests Ordinance No. 42 of 1915 His Excellency the Governor in Executive Council has been pleased to prescribe the following form of license for the extraction of Gum from Balata trees growing on Private Land.

LICENSE TO EXTRACT GUM FROM BALATA TREES ON PRIVATE LANDS
(UNDER SECTION 4 OF FORESTS ORDINANCE No. 42 OF 1915).

License No.

Permission is hereby granted to.....of.....
to extract gum from.....Balata trees situated on an area
of... ..a.....r.....p. owned by.....
and situated in the Ward ofsubject to the following
conditions :—

- 1.—This license is not transferable.
- 2.—The names of the persons who are actually to cut the Balata trees for the purpose of extracting the gum must be written on the back of this license, before the work is begun.
- 3.—The licensee must notify the Warden in writing of the date on which the cutting of the trees is actually commenced.
- 4.—The licensee must notify the Warden in writing of the date when the cutting of the trees is finished.
- 5.—This license comes into force on the.....
- 6.—This license expires on the... ..
- 7.—This license does not authorise the cutting of Balata trees on any land which is not in fact the property of the licensee except with the permission of the owner of such land.
- 8.—This license must be produced by the licensee on the demand of a Forest Officer, Warden, Member of the Constabulary Force or Rural Constable.
- 9.—In the event of any breach of the conditions of this license, it may be cancelled by me the undersigned, and thereupon such license shall become void and of no effect.

Date.....

.....
Warden.

Forms of application can be obtained from the Warden.

By Command,

(Sgd.) W. M. GORDON,
Acting Colonial Secretary.

FORESTS ORDINANCE.

TRINIDAD AND TOBAGO.

No. 42.—1915.

I ASSENT,

[L.S.]

S. W. KNAGGS,
Acting Governor.

31st December, 1915.

AN ORDINANCE to consolidate and amend the Law relating to Forests and Forest Produce.

[On Proclamation.] ⁽¹⁾

Be it enacted by the Governor of Trinidad and Tobago with the advice and consent of the Legislative Council thereof as follows:—

1. This Ordinance may be cited as the Forests Ordinance, 1915.

2. In this Ordinance, unless there is anything repugnant in the subject or context:—

“Intendant” means the Governor as Intendant of Crown Lands.

“Forest Officer” includes any person appointed to discharge any function of a Forest Officer under this Ordinance or any rule made under it.

“Forest Offence” means any offence punishable under this Ordinance or under any rule made under it.

“Crown Land” includes:—

- (a.) The waste or vacant land of the Crown within the Colony; and
- (b.) All lands vested in His Majesty, whether by forfeiture, escheat, purchase or exchange, and not dedicated to the public.

“Private Land” means land other than Crown Land.

“Forest Reserve” means and includes a forest and every part of a forest declared to be a forest reserve under the Land Regulations for the time being in force.

“Tree” includes palms, bamboos, stumps, brushwood and canes.

“Forest-produce” includes the following when found in or brought from Crown Land:—

- (1.) Trees and all parts of produce of such trees;
- (2.) Plants not being trees, and all parts or produce of such plants.

“Timber” includes trees when they have fallen or been felled, and all wood whether cut up or fashioned for any purpose or not.

“Property mark” means a mark placed on timber to denote that after all purchase money or royalties due to the Government shall have been paid, the owner has or will have a right of property in the timber.

“Cattle” includes horses, mules, asses, goats, and swine.

“Public road” has the meaning given to it by Section 2 of the Roads Ordinance, No. 200.

“Ward Officer” includes an Assistant Ward Officer.

(1.) The Ordinance was proclaimed on May 15, 1916.

Establishment.

3. The Governor may appoint such and so many persons to be Forest Officers as may be necessary to carry out the provisions of this Ordinance, and may by writing under his hand confer upon any such Officer or upon any Warden power or authority either generally or in a specific case, to do any act or grant any permission for which power or authority is required under the provisions of this Ordinance.

Appointment
of Officers.

Balata Gum.

4.—(1.) If any person shall extract gum from, or cut for the purpose of extracting gum, any Balata trees growing on Crown lands he shall be liable to a penalty not exceeding fifty pounds or in default of payment to imprisonment with or without hard labour for a term not exceeding three months.

Balata gum
from Crown
lands.

(2).—(a.) It shall be unlawful for any person whomsoever to extract gum from, or to cut for the purpose of extracting gum, any Balata tree growing on Private Land without the licence in writing first had and obtained, of the Warden of the district in which such land is situated.

Balata gum
from private
lands.

(b.) Such licence shall be in such form and subject to such conditions as the Governor in Executive Council may from time to time determine.

(c.) Any person who commits any contravention of the provisions of this sub-section or of any condition contained or endorsed on any licence issued to him by a Warden shall be liable to a penalty not exceeding Fifty pounds or, in default of payment, to imprisonment, with or without hard labour for a term not exceeding three months.

5.—(1.) It shall not be lawful for any person to convey or remove Balata gum except under a written permit from the Warden of the district. Every such permit shall be in the form in the First schedule hereto, shall only be granted on the Warden being satisfied that the Balata gum in respect of which the permit is applied for has been obtained from trees growing on private land with the consent of the owner of such land, and shall only hold good for the period therein mentioned.

Permit for
removal of
gum.

(2.) Any person contravening the provisions of the preceding sub-section is liable on conviction before a magistrate to a penalty not exceeding Fifty pounds or in default of payment to imprisonment with or without hard labour for a term not exceeding three months.

Removing gu
without
permit.

6.—(1.) It shall not be lawful for any person to export from this Colony any Balata Gum unless in the case of local produce the shipping bill presented to the Collector of Customs is accompanied by a Warden's permit under Section 5, or in the case of imported gum by a certificate of its landing signed by an officer of Customs.

Export of
Balata gum.

(2.) Whoever exports or attempts to export from the Colony any Balata gum in contravention of the provisions of the preceding sub-section is liable to a penalty not exceeding Fifty pounds, or in default of payment to imprisonment with or without hard labour for a term not exceeding three months.

Unlawfully
exporting
Balata gum.

Removal of Timber.

Permit to
move timber.

7.—(1.) It shall not be lawful for any person within a proclaimed district to convey or move any timber, the produce of the Colony, along any public road, or by railway or water except under a written permit from an officer authorized to issue the same, and any person acting in contravention of the provisions of this section is liable to a penalty not exceeding Twenty Pounds or in default of payment to imprisonment with or without hard labour for a term not exceeding one month.

(2.) "Timber" in this section and in Section 11 hereof means timber cut from trees mentioned in the Second schedule to this Ordinance. The Governor in Executive Council may from time to time by Proclamation in the *Royal Gazette* add to or deduct from the trees from time to time specified in such schedule.

(3.) A "proclaimed district" means any part of the Colony as to which the Governor in Executive Council may from time to time, by proclamation in the *Royal Gazette* declare that the provisions of this Ordinance with regard to the removal of timber shall apply. Any such proclamation may be altered or revoked by the Governor in Executive Council.

(4.) The production of a copy of the *Royal Gazette* containing any proclamation shall be *prima facie* evidence in all Courts and for all purposes whatsoever of the due making and tenor of such proclamation.

Offences and Procedure.

Forest
offences.

8. If any person shall do any of the following acts:—

- (a.) Pasture cattle or permit cattle to trespass, or
- (b.) Fell, cut, girdle, mark, lop, tap, or bleed any tree, or injure by fire or otherwise any tree or timber, or
- (c.) Cause any damage by negligence in felling any tree, or cutting or dragging any timber, or
- (d.) Kindle, keep or carry any fire except at such seasons and in such manner as the Intendant may from time to time notify, or
- (e.) Subject to any manufacturing process or convey or remove any forest-produce,

he shall be liable to a penalty not exceeding £50 or in default of payment to imprisonment with or without hard labour for a term not exceeding three months if the act was committed in a Forest Reserve, and to a penalty not exceeding £20 or in default of payment to imprisonment with or without hard labour for a term not exceeding one month if the act was committed on Crown land not included in a Forest Reserve: provided always that nothing contained in this section shall subject any person to any penalty thereunder for any act done in accordance with the rules made by the Intendant or with permission in writing given by a Forest Officer or Warden empowered or authorized to grant such permission.

Fences with
intent to cause
damage or
wrongful gain.

9. Whoever,

- (a.) knowingly counterfeits upon any tree or timber, or has in his possession any implement for counterfeiting, a mark used by Forest Officers to indicate that such tree or timber is the property of the Government, or of some person, or that it may lawfully be felled or removed by some person; or

(b.) unlawfully or fraudulently affixes to any tree or timber a mark used by Forest Officers, or

(c.) alters, defaces or obliterates any such mark placed on any tree or timber by or under the authority of a Forest Officer ;

is liable to a penalty not exceeding £50, or to imprisonment with or without hard labour for any term not exceeding three months.

10. Any Forest Officer, Warden, or any person authorised by either of them and any Ward Officer, Rural Constable or member of the Constabulary Force may seize any cattle found trespassing on a forest reserve and deal with the same under the provisions of the Pound Ordinance (No. 12) in the same way in all respects as poundable animals may be dealt with under the provisions of such last mentioned Ordinance.

11. It shall be lawful for a Forest Officer or Warden or for any person authorized by such Forest Officer or Warden, or for any Ward Officer, Rural Constable or member of the Constabulary Force, in any public road or place to stop any person conveying or removing or whom he may have cause to suspect is conveying or removing Balata gum or timber the produce of the Colony, and to demand the production of the permit for such removal or conveying, and if such person is conveying or removing such Balata gum or timber and fails to produce such permit or to account satisfactorily for its absence, such Forest Officer, Warden, authorized person, Ward Officer, Rural Constable or member of the Constabulary Force may arrest such person and take him and such gum or timber before a Magistrate or Justice or the Officer or Non-commissioned Officer in charge of the nearest Constabulary station to be dealt with according to law, provided always that in the case of timber the powers conferred by this Section shall only be exercised in respect of timber as defined in Section 7 of this Ordinance and within a proclaimed district as also therein defined.

12.—(1.) Any Forest Officer, Warden, Ward Officer, Rural Constable or member of the Constabulary force may, without a warrant, arrest any person reasonably suspected of having been concerned in any forest-offence if such person refuses to give his name and residence, or gives a name or residence which there is reason to believe to be false, or if there is reason to believe that he will abscond.

(2.) Every person making an arrest under the preceding sub-section shall without unnecessary delay, take or send the person arrested before a Magistrate or Justice or the Officer or Non-commissioned Officer in charge of the nearest Constabulary station to be dealt with according to law.

13.—(1.) When there is reason to believe that a forest-offence has been committed in respect of any forest-produce, such produce, together with all tools, ropes, chains, boats, crafts, carriages, carts and cattle used in the commission of such offence, may be seized by any Forest Officer, Warden or person authorized by either of them, or by any Ward Officer, Rural Constable or member of the Constabulary force.

(2.) Every person seizing any property under this Section shall, as soon as may be, make a report of such seizure to a Magistrate.

Provided that when the Forest produce with respect to which such offence is believed to have been committed is the property of the Government and the offender is unknown, it shall be sufficient if the Officer makes, as soon as may be, a report of the circumstances to his Official Superior.

(8.) All such property shall be forfeited to His Majesty and shall be taken to be condemned and may be sold by the Forest Officer or Warden of the district in which the seizure took place, unless the person from whom the same shall have been seized or the owner thereof or some person authorized by him shall within fourteen days of seizing the same, claim the same and shall within the said term of fourteen days, or such further term as a Magistrate may allow, prove to the satisfaction of such Magistrate that such forest-produce was not obtained from Crown land, or that such person had some sufficient license or authority in that behalf.

(4.) In lieu of the forfeiture of any of the things other than forest-produce mentioned in the preceding sub-section, the Magistrate may order the owner thereof to pay such fine not exceeding £20 as the Magistrate may think fit, and on payment of such fine such things shall be returned to the owner.

(5.) Whoever seizes any forest-produce or any property under this section shall place on such forest-produce or property, or the receptacle, if any, in which it is contained, a mark indicating that the same has been seized.

(6.) Notwithstanding anything in this section contained, a Forest Officer may direct at any time the immediate release of any property seized under the provisions of this section which is not the property of the Crown, and the withdrawal of any charge made in respect of such property.

14.—(1.) When any person is convicted of felling, cutting, removing, girdling, marking, lopping, tapping or bleeding trees or timber, or of injuring them by fire or otherwise, in contravention of this Ordinance, the convicting Court may, in addition to any other punishment which it may award, order that person to pay to the Government such compensation, not exceeding One Pound, for each tree or log of Timber with respect to which the offence was committed, as it deems just.

(2.) If the person convicted of the offence committed is the agent or servant of another person, the convicting Court may, unless after hearing that other person it is satisfied that the commission of the offence was not a consequence of his instigation or of any neglect or default on his part, order him, instead of the person who committed the offence, to pay the compensation referred to in Sub-section (1) of this Section.

15.—(1.) When any person is convicted of a forest-offence, all forest-produce in respect of which such offence has been committed, and all tools, ropes, chains, boats, crafts, carts, carriages and cattle used in the commission of such offence, shall be liable by order of the convicting Court to be forfeited to His Majesty or to be otherwise dealt with as to

the Court in the particular circumstances of the case seems just. Such forfeiture may be in addition to any other penalty or compensation prescribed for such offence.

(2.) Any thing or any cattle mentioned in the preceding sub-section shall, if forfeited to His Majesty, be taken possession of by a Forest Officer or Warden empowered in this behalf and in any other case, may be disposed of in such manner as the Court may order.

16. The Magistrate may, notwithstanding anything in this Ordinance contained, direct the sale of any property seized under this Ordinance and subject to speedy or natural decay, and may deal with the proceeds as he might have dealt with such property, if it had not been sold.

17.—(1.) Any offence under this Ordinance may be prosecuted and any penalty recovered before any Magistrate in manner prescribed by the Summary Conviction Offences (Procedure) Ordinance No. 1 on the complaint of a Forest Officer, Warden, Ward Officer or member of the Constabulary Force.

(2.) All such complaints may be made at any time within six months from the time when such matter of complaint arose.

18. Every Forest Officer, Warden, Ward Officer, Rural Constable and member of the Constabulary Force is hereby authorized to prevent the commission of any forest offence.

19. In any action brought against any person for anything done or *bonâ fide* intended to be done in the exercise or supposed exercise of the powers given by this Ordinance or by any regulations made thereunder, it shall be expressly alleged that the defendant acted maliciously and without reasonable and probable cause, and if at the trial the plaintiff fails to prove such allegation, judgment shall be given for the defendant.

20. When in any proceedings taken under this Ordinance or in consequence of anything done under this Ordinance, a question arises as to whether any forest-produce is the property of the Government, such produce shall be presumed to be the property of the Government until the contrary is proved.

21.—(1.) The Governor may by writing under his hand empower a Forest Officer:—

- (a.) to accept from any person against whom a reasonable suspicion exists that he has committed any forest-offence, other than an offence specified in Section 9, a sum of money not exceeding Ten Pounds by way of compensation for the offence which such person is suspected to have committed; and
- (b.) when any property has been seized as liable to confiscation, to release the same on payment of the value thereof as estimated by such officer.

(2.) On payment of such sum of money or such value, or both, as the case may be, to such officer, the suspected person, if in custody, shall be discharged, the property, if any, seized shall be released and no further

proceedings shall be taken against such person or property in respect of such suspected offence.

(3.) All moneys received under this section shall be paid into the Colonial Treasury.

22. The Governor may order such rewards as he thinks fit to be paid in respect of any seizure made under this Ordinance to the person making such seizure or through whose information or means such seizure was made.

23. The Governor may make rules :—

- (a.) Prescribing the form of permits and providing for their issue, production and return;
- (b.) Regulating the issue of property-marks for timber and the registration of such marks and declaring the circumstances in which the registration of any property-marks may be refused or cancelled; prescribing the time for which such registration shall hold good; limiting the number of such marks that may be registered by any one person, and providing for the levy of fees for such registration.
- (c.) Providing for the preservation of trees, remarkable for size, rarity, or beauty, whether generally or in individual cases, and for obtaining permission to lop or fell the same.

24.—(1.) Subject to the provisions of this Ordinance, Rules made hereunder shall not have any force until they have been approved by the Legislative Council, and when so approved by resolution shall have the same force and effect as if they were contained in and formed part of this Ordinance.

(2.) All rules made under this Ordinance shall be published in the *Royal Gazette*.

25. The Forest Produce Ordinance No. 240, the Balata Gum Ordinance 1905 (No. 87 of 1905) and the Balata Gum Ordinance 1906 (No. 22—1906) are hereby repealed.

26. This Ordinance shall commence on a day to be proclaimed by the Governor.

Passed in Council this Seventeenth day of December, in the year of Our Lord one thousand nine hundred and fifteen.

J. M. FARFAN,
Acting Clerk of the Council,

FIRST SCHEDULE,

The Forests Ordinance 1915.

WARDEN'S OFFICE,

191 .

PERMISSION is hereby granted to _____ to remove
 from _____ to _____ piece
 of Balata Gum weighing _____

This permit shall hold good for the period of _____ days from the
 date thereof.

Warden.

SECOND SCHEDULE.

Local Name.	Botanical Name.
Cedar 	<i>Cedrela odorata</i> , L.
Poui . .	<i>Tecoma serratifolia</i> , Don.
Balata . . .	<i>Minusops globosa</i> , Gaertn.
Locust 	<i>Hymenaea courbaril</i> , L.
Cyp 	<i>Cordia gerascanthus</i> , Jacq.
Balsam 	<i>Copaifera officinalis</i> , L.

METEOROLOGY.

RAINFALL RETURN JULY TO SEPTEMBER, 1918.

Stations.	July.	August.	Sept.	January to Sept., 1918.	January to Sept., 1917.
<i>North-west District.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>
St. Clair—Royal Botanic Gardens ...	14.42	8.56	7.24	46.11	43.98
Port-of-Spain—Colonial Hospital ...	11.76	7.14	6.09	37.13	38.33
„ Royal Gaol... ..	11.12	7.05	7.36	42.65	40.62
„ Constabulary Headquarters ...	10.42	6.43	6.37	35.39	37.51
St. Ann's—Reservoir ...	18.73	12.38	9.16	61.15	57.16
Maraval— „ ...	13.63	11.09	10.68	53.64	50.44
„ Constabulary Station ...	14.87	11.03	12.11	57.05	59.79
Diego Martin—Constabulary Station ...	16.73	14.19	7.21	64.59	64.57
„ Waterworks ...	14.69	11.45	6.87	53.56	55.66
„ River estate ...	14.84	11.87	6.73	54.43	50.31
Fort George Signal Station ...	13.83	9.14	11.84	50.56	43.57
North Post „ ...	10.59	...	3.62	...	42.68
Carenage Constabulary Station ...	18.31	9.60	7.48	55.69	55.18
Carrera Island Convict Depot ...	5.38	2.44	1.81	15.00	15.86
Chacachacare Lighthouse ...	13.23	4.74	3.29	39.78	39.05
<i>Santa Cruz—Maracas District.</i>					
Santa Cruz—Constabulary Station ...	16.06	16.14	7.92	61.75	69.00
St. Joseph—Government Farm ...	13.38	9.61	5.91	44.30	46.00
„ Constabulary Station ...	12.61	7.61	4.22	35.41	42.37
Tunapuna—St. Augustine estate ...	13.53	8.50	6.15	42.93	38.57
Maracas—Government School ...	...	...	10.02	...	60.84
„ Ortinola estate ...	15.73	12.98	5.08	55.61	55.85
„ San José estate ...	13.78	8.04	7.15	47.80	...
Caura—Wardour estate ...	11.70	11.35	5.22	46.93	47.35
<i>West Central District.</i>					
Caroni Frederick estate ...	15.35	7.85	4.13	47.88	40.50
Chaguanas—Constabulary Station ...	11.55	8.96	6.41	42.53	45.62
„ Woodford Lodge estate ...	12.00	8.24	5.67	41.68	37.90
Carapichaima—Waterloo estate ...	12.82	10.06	6.05	49.40	44.18
„ McBean Cacao estate ...	13.18	9.46	5.88	45.79	39.29
„ Friendship Hall estate... ..	12.74	8.10	6.69	...	42.30
Couva—Exchange estate ...	10.51	9.51	4.33	36.10	39.03
„ Brechin Castle estate ...	11.04	9.30	6.12	43.87	41.94
„ Perseverance „ ...	10.75	11.46	5.54	40.15	36.95
„ Camden „ ...	9.87	8.68	4.89	...	36.32
„ Milton „ ...	11.65	10.62	6.02	46.87	44.09
„ Spring „ ...	8.17	8.43	4.34	44.05	46.83
„ Constabulary Station ...	9.59	10.82	5.30	39.26	25.06
„ Esperanza estate ...	7.83	8.76	6.45	38.54	36.91
<i>Montserrat District.</i>					
Brasso-Piedra—Mamoral estate ...	17.89	6.40	4.97	62.31	62.56
„ La Mariana estate ...	18.27	5.97	4.98	58.85	58.59
Montserrat Constabulary Station ...	13.25	8.91	6.42	45.98	42.87
Brasso—La Vega estate ...	17.10	7.06	4.44	58.00	61.55
<i>Arima District.</i>					
Arima—Warden's Office ...	19.68	7.10	8.91	60.24	...
„ Torrecilla estate ...	21.38	8.88	9.49	69.30	64.98
„ Verdant Vale estate ...	18.42	7.49	7.64	50.76	61.14
San Rafael—Constabulary Station ...	17.85	8.79	3.68	63.53	64.11
Guanapo—Talparo estate ...	18.64	9.34	7.20	66.43	72.41
„ San José Estate ...	20.93	8.59	6.35	72.10	69.24
Tamana—Sta. Marta estate ...	23.28	6.15	5.85	73.10	81.29
„ La Corona estate ...	19.29	6.28	5.82	68.98	72.69
<i>San Fernando & Princes Town District.</i>					
Claxton's Bay—Forres Park estate ...	9.34	6.42	5.31	39.14	35.85
Pointe-à-Pierre—Bonne Aventure est. ...	11.71	8.79	6.11	48.09	42.36
„ Concord estate ...	11.34	11.53	5.68	51.88	48.40
„ Plein Palais estate ...	8.31	9.65	7.19	43.48	48.15
Naparima—Picton estate ...	9.49	7.96	3.47	44.03	49.98
„ Usine St. Madeleine estate ...	8.74	5.73	5.59	42.61	44.67
„ La Fortunée estate ...	7.01	8.41	1.88	35.70	48.47
„ Tarouba estate ...	6.15	9.22	3.94	32.06	41.51
„ Union Hall estate ...	8.27	7.52	4.41	42.16	54.23

RAINFALL RETURN—JULY TO SEPT., 1918.—CONTINUED.

Stations.	July.	August.	Sept.	January to Sept., 1918.	January to Sept., 1917.
<i>San Fernando and Princes Town District.—(Contd.)</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>
Naparima—Palmiste estate ...	11.16	8.91	4.31	48.11	65.12
" Lewisville House ...	10.84	12.97	6.90	52.61	60.12
" Hermitage estate ...	9.12	8.26	3.41	42.36	49.44
" Petit Morne estate ...	8.43	5.77	5.93	37.93	42.96
Princes Town—Craigish estate ...	12.38	8.62	6.53	52.29	36.59
" Cedar Hill estate ...	11.32	7.47	6.51	48.50	45.96
" Williamsville estate ...	12.12	11.04	6.20	50.90	39.46
" Emeraldale estate ...	14.81	7.76	6.37	63.68	50.85
" New Grant estate ...	13.70	6.49	6.32	61.29	46.51
" Constabulary Station ...	8.81	4.85	5.04	39.14	36.53
" Hindustan estate ...	11.43	4.21	6.58	48.09	49.14
" La Retraite estate ...	20.92	7.83	8.68	77.56	64.99
" Malgretoute estate ...	13.75	9.19	7.77	55.33	44.46
" Friendship & Ben Lomond estates ...	12.48	8.13	7.02	52.03	46.56
" Los Naranjos estate ...	12.48	5.97	4.83	48.92	51.15
Poole—El Rosario estate ...	19.48	5.72	6.54	66.98	64.06
<i>South-west District.</i>					
Oropuche—Constabulary Station ...	11.90	7.45	3.25	48.29	55.61
" Pluck estate ...	...	4.18	3.16	...	44.36
Siparia—Constabulary Station ...	13.37	5.31	5.49	52.15	55.08
" Alta Gracia estate ...	13.96	7.75	7.06	57.91	54.34
Guapo—Adventure estate ...	10.01	6.88	5.86	45.33	59.68
Point Fortin—Constabulary Station ...	13.78	7.78	6.50	53.49	72.27
Erin—La Ressource estate ...	8.58	3.86	96	32.76	52.44
" La Union estate ...	10.02	2.45	86	37.39	55.70
" Industry estate ...	11.08	4.05	1.31	41.44	56.41
Cedros—La Retraite estate ...	13.34	6.68	3.49	51.63	69.07
" Beaulieu estate ...	...	2.77	46	...	53.02
" Perseverance estate ...	10.32	3.60	Nil	37.97	61.01
" St. Marie estate ...	10.88	4.33	61	40.51	61.66
" Constabulary Station ...	10.57	3.88	26	37.48	59.99
" St. Quintin estate ...	11.50	2.52	39	38.32	53.45
Icaicos—Constance estate ...	38.80	6.33	24	101.95	111.40
Irois—Government School ...	12.34	4.00	3.29	44.09	74.62
<i>South Coast.</i>					
Moruga—Constabulary Station ...	13.06	3.00	2.89	42.91	53.65
<i>East Coast.</i>					
Matura—La Juanita estate ...	18.20	9.95	7.42	76.60	69.02
Manzanilla—Constabulary Station ...	18.44	7.16	5.81	70.02	70.09
" Indrasan estate ...	17.37	12.69	7.26	74.76	...
Sangre Grande—New Lands estate ...	23.29	8.68	6.30	77.39	77.02
" Evasdale estate ...	21.06	11.19	5.02	75.64	66.74
" Grosvenor estate ...	21.15	10.91	4.88	76.66	75.61
" * San Hilario estate ...	19.90	11.51	5.18	67.21	63.87
" San Francisco estate ...	15.78	8.40	6.60	72.60	...
Mayaro—Constabulary Station ...	12.46	4.83	5.96	50.85	55.49
<i>North Coast.</i>					
Blanchisseuse—Constabulary Station ...	15.23	8.50	3.44	66.41	66.29
Grande Rivière—Mon Plaisir estate ...	16.60	11.03	5.63	78.79	71.34
Toco—Aragua House ...	15.20	7.84	3.39	62.77	54.77
" Constabulary Station ...	16.47	4.65	2.79	55.11	60.99
Point Galera—Light House ...	12.45	5.58	3.47	48.31	49.72
<i>Tobago.</i>					
Tobago—Hermitage estate ...	13.79	4.10	...	58.12	68.99
" King's Bay ...	13.68	2.46	10.11	58.12	67.69
" Roxburgh ...	17.19	4.80	12.43	...	65.81
" Lure estate ...	27.24	10.70	23.27	92.42	59.96
" Botanic Station ...	15.20	3.18	7.52	51.96	52.09
" Government Farm ...	9.98	2.51	5.12	36.61	38.34
" Lowlands estate ...	...	...	...	...	...
" Friendship ...	13.11	4.31	4.07	44.19	39.17
" Riversdale ...	14.21	5.52	7.13	49.05	58.48

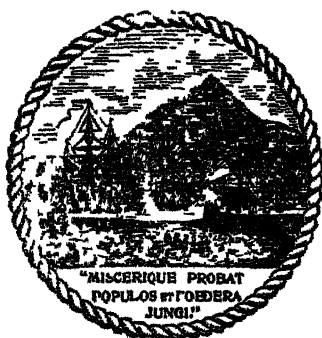
* Gauge removed to El Recuerdo Estate.

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BULLETIN
OF THE
DEPARTMENT OF AGRICULTURE
TRINIDAD & TOBAGO.

Issued by the Department and Board of Agriculture



29132/36

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DEPARTMENT OF AGRICULTURE.

Agricultural Credit Societies

under Ordinance No. 80, 1915.

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Diego Martin, Trinidad.	Delaford, Tobago.
Pembroke, Tobago.	Moriah, Tobago.
Scarborough, Tobago.	Mason Hall, Tobago.
Charlotteville, Tobago.	

Plant Protection Ordinance.

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	{ J. BLACKMAN.
	{ R. H. LEACOCK (Actg.)

Froghopper Investigations.

Special Appointment.

C. B. WILLIAMS, M.A., (Camb.) F.E.S.

Reference Library.

THIS Library can be consulted at the Head Office of the Department, St. Clair Experiment Station. It contains standard works on General Agriculture, Horticulture, Botany, etc., and books and periodicals dealing with Cacao, Sugar, Coconuts, Rubber, Cotton, Corn, Fruit, Tobacco, and other crops.

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J. BLACK.	J. DUNCAN MILLER, M.R.C.V.S.
A. B. CARR.	W. S. E. BARNARDO.
	J. J. CARLEE.

<i>Mycologist</i>	J. B. ROBER, M.A. *
<i>Entomologist</i>	F. W. URICH, F.E.S., C.M.Z.S.
	C. M. ROACH, San Fernando.
<i>Agricultural Advisers</i>	F. D. DAVIES, Tobago.
	L. MOTA, Rio Claro.
<i>Laboratory and Field Assistant</i>	W. BUTHN.
<i>Secretary</i>	

* On leave for a year from December, 1914.

Standing Committees.

ADVISORY COMMITTEE.—This consists of all the members of the Board; five as a Quorum.

FINANCE COMMITTEE.—The Director of Agriculture, Hon. Sir G. Townsend Fenwick, K.C.M.G., Hon. Carl de Verteuil, Messrs. Wm. Greig, J. J. McLeod and A. B. Carr.

CACAO COMMITTEE.—The Director of Agriculture, Messrs. J. d'Abadie, Ludovic de Verteuil, J. P. Bain, A. B. Carr, W. C. Jardine and W. S. E. Barnardo.

SUGAR COMMITTEE.—The Director of Agriculture, Hon. Sir Norman Lamont, Bt., Hon. Sir G. Townsend Fenwick, K.C.M.G., Hon. W. G. Kay, Messrs. C. Forbes Todd, J. Black, J. J. McLeod and J. W. Arbuckle.

RUBBER COMMITTEE.—The Director of Agriculture, Hon. Sir Norman Lamont, Bt., Hon. R. S. A. Warner, K.C., Messrs. C. S. Rogers and Wm. Greig.

GOVERNMENT FARM ADVISORY COMMITTEE.—The Director of Agriculture, Messrs. J. W. Arbuckle, J. J. McLeod, J. Black, C. Forbes Todd.

STATISTICS COMMITTEE.—The Director of Agriculture, Hon. Sir Norman Lamont, Bt., Hon. Sir G. Townsend Fenwick, K.C.M.G., Messrs. W. C. Jardine, Wm. Greig, A. B. Carr.

AGRICULTURAL EXHIBITION COMMITTEE.—The Director of Agriculture, Hon. Sir G. Townsend Fenwick, K.C.M.G., Hon. W. G. Kay, and Mr. Ludovic de Verteuil.

Department of Agriculture.

GOVERNMENT STUD ANIMALS.

THE following are the arrangements for February and March with regard to Stud animals of the Government Farms in Trinidad and Tobago.

Stallions.

<i>Name.</i>	<i>Class.</i>	<i>Where standing for Service.</i>	<i>Fee.</i>	<i>Groom's Fee.</i>
QUICKMATCH.	Thorough-bred	Govt. Farm Trinidad	\$ 10.00	60c.
SIR HORRY...	Thor'gh-bred Hackney	Govt. Farm	5.00	60c.
SIR HORACE...	Half-bred Hackney	Govt. Farm	5.00	60c.
RILLINGTON SPARTAN.	Cleveland Bay	Govt. Farm	5.00	60c.
MARAT	Thorough-bred	Govt. Farm Tobago	4.80	60c.

Jack Donkeys.

Monarch	American Donkey	Govt. Farm	\$ 5.00	60c.
President	Do. do.	Govt. Farm, Tobago	5.00	60c.

Bulls.

A.—AT GOVERNMENT FARMS.

TRINIDAD.

1	Pure-bred Shorthorn	\$ 2.40c.
2	" Zebu	1.20c.
1	" Jersey	2.40c.
2	Half-bred Red Poll	1.20c.
1	" Shorthorn	1.20c.
1	" Holstein	1.20c.

TOBAGO.

1	Pure-bred Shorthorn	2.40
1	Pure-bred Zebu	1.00
1	Half-bred Guernsey	1.00

B.—AT PUBLIC PASTURES OR ESTATES.

Queen's Park Savannah	2	Half-bred Shorthorn;	1	Half-bred Guernsey.
Mucurapo Pasture:	1	Pure-bred Shorthorn;	1	Half-bred Holstein.
St. Augustine Estate:	1	Half-bred Holstein;	½	Bred Shorthorn;
			½	Bred Guernsey.
River Estate:	1	Half-bred Zebu;		
San Fernando:	1	Pure-bred Holstein;	½	Bred Jersey.
Arima:	1	Half-bred Jersey.		
Tobago, Friendship Est.	1	Half-bred Holstein.		

Pigs.

AT GOVERNMENT FARM, TRINIDAD.

White Yorkshire, Berkshire, TamworthFee \$1.00:
Attendant's Fee	25c.	

AT GOVERNMENT FARM, TOBAGO.

BerkshireFee 50c.
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POULTRY.

GOVERNMENT FARM, TRINIDAD.

Eggs of Barred Plymouth Rocks, Black Minorcas, Biahmas (light), Rhode Island Reds, White Leghorns\$1.00 per doz.
Great Kind Pigeons	...	40c. and 60c. per pair.

GOVERNMENT FARM, TOBAGO.

Eggs of Plymouth Rocks, Black Minorcas, Rhode Island Reds 48c. per doz.
Also Cocks and Pullets of Plymouth Rocks and Rhode Island Reds.

Department of Agriculture.

NURSERY STOCK.

Orders for Cacao, Coffee, Oranges, Grape Fruit, and Limes for next season should be sent in without delay addressed to the Acting Superintendent, St. Clair Experiment Station, or to the Officer in Charge Botanic Station, Tobago.

Special quotations at St. Clair for Cacao, Coffee and Limes grown from selected seeds are as follows :—

Plants purchased in lots of 1 to 1,000 plants	} Delivered at Nurseries uncrated.
3 cents per plant.	
Plants purchased in lots of several thousands	}
2½ cents per plant.	
Plants purchased in lots up to 100 at 4 cents per plant.	} Delivered at Railway Station, Port-of- Spain or Queen's Wharf, securely packed in open crates.
Plants purchased in lots up to 1,000 at \$3.50 per 100.	
Plants purchased in lots of several thousands at \$38.00 per 1,000.	

Tobago prices on application at the Botanic Station, Scarborough.
Budded Avocados select varieties at 12 cents, Budded Oranges at 24 cents and Grafted Mangos at 24 cents should also be booked at once.
Budded Cacao 12 cents each or in lots of over 100 at 8 cents.
Limes from beds 1½ cents per plant for lots over 100.

A select stock is also kept of other fruit, ornamental and flowering trees, palms, etc., a list of which can be obtained on application. Large orders must be booked six months previous to the date when the plants are required as large supplies are not kept on hand for casual demands.

Board of Agriculture.

SPRAYING CACAO, &c.

From September to November is the time for spraying cacao trees for the prevention of thrips and black rot; and early in the dry season for the Algal disease, die back, and cacao beetles.

The Board of Agriculture has on hand a supply of bluestone, which is sold to planters at 14½ cents per pound, also nicotine sulphate, the best insecticide for thrips, which is sold at \$10.70 per gallon.

Men will be provided to superintend any spraying work which estates may wish to have done.

Further information in regard to cost of spraying, etc., and applications for bluestone and nicotine sulphate should be made to

THE SECRETARY,
Board of Agriculture,
Port-of-Spain.

PUBLICATIONS FOR SALE.

THE BULLETIN issued quarterly, price sixpence per number, or two shillings per annum post free in the Colony. To other subscribers postage extra.

Part 1. 1918.—Report on St. Lucia Lime Factory. Storage of Black-eye Peas (Illustrated); Fruits of Trinidad and Tobago; Uses and culture of Dasheens (Illustrated), Prize Competition Reports; etc., etc.

Part 2. 1918.—*Coffea excelsa*; Yam cultivation; Insects affecting Vegetables; Rubber Tapping Experiments; Tobago Orchids, etc.

Part 3. 1918.—Agricultural Co-operation in the West Indies; Agricultural Credit Societies; Sugar Cane Experiments; Trinidad Thrips, etc., etc., etc.

OUR LOCAL FOODS: THEIR PRODUCTION AND USE, by W. G. Freeman, and R. O. Williams.—Price 8d.

THE DASHEEN: Its Uses and Culture.—Illustrated.—Price 8d.

INSECTS AFFECTING VEGETABLES IN TRINIDAD AND TOBAGO, by F. W. Urich. Symptoms of pests, Treatment, Preparation of Insecticides, etc.—Illustrated.—Price 8d.

LIFE HISTORY AND CONTROL OF THE CACAO BEETLE, 8 coloured plates, by P. L. Guppy.—Price 6d.

INSECT NOTES FOR 1910-11. Miscellaneous Notes on Cacao Pests, by F. W. Urich.—Price 8d.

NOTES ON SOME INSECTS AFFECTING THE COCONUT PALM, one coloured plate by F. W. Urich and P. L. Guppy.—Price 8d.

THE COTTON STAINER BUG (Illustrated), by P. L. Guppy and Thomas Thornton.—Price 8d.

REARING OF THE VERMILION FROGHOPPER EGG PARASITE, by F. W. Urich.—Price 1d.

THE SUGAR CANE FROGHOPPER, six plates (8 coloured), by F. W. Urich.—Price 9d.

THE SURINAM WITCH-BROOM DISEASE OF CACAO, by J. B. Rorer.—Price 8d.

THE FROGHOPPER EGG PARASITE AND ITS COLONIZATION IN CANE FIELDS, by F. W. Urich.—Price 1d.

THE MONGOOSE IN TRINIDAD AND METHODS OF DESTROYING IT, 2 plates, by F. W. Urich.—Price 8d.

ANNUAL REPORTS, DEPARTMENT OF AGRICULTURE, 1917 AND 1918.—Price 1s. 9d. each.

All publications can be obtained from the Head Office of the Department, St. Clair Experiment Station, and sent post free within the Colony.

The Bulletin is also on sale at Messrs. Muir, Marshall, and Davidson & Todd, Port-of-Spain.

BULLETIN
OF THE
DEPARTMENT OF AGRICULTURE
Trinidad and Tobago.

PART 4.]

1918.

[VOL. XVII.]

Cassava as a Main Crop.—Considerable attention was directed to cassava cultivation in the Colony in 1914 and 1915. In the former year the Oarenage factory was opened for the preparation of cassava starch, and in the latter Mr. Vyvyan Board erected a temporary plant for the manufacture of cassava flour at Palmiste Estate, having arranged with Sir Norman Lamont and Tennants Estates, Ltd., for the cultivation of the necessary acreage. The Board of Agriculture paid a visit to Palmiste in January, 1915, to inspect the factory, and later in the day held a meeting at San Fernando, when the possibilities of a cassava industry were fully discussed. (See *Bulletin* XIV. 1915, 27-57).

In the course of this discussion it was pointed out that there was much to be learnt regarding the yield of cassava in Trinidad. No interest had been taken in it up to that time as a main crop, but judging by the results in other countries a yield of 8 tons of roots per acre was a reasonable expectation. To secure this however experiments were necessary to ascertain the yields of varieties, the best distance to plant, when to plant and when to reap, including under the latter not only the season of the year, but also the age at which the crop should be dug.

The early results were very disappointing, the yield per acre being low. Mr. Board left for Active Service, and the experimental factory was closed down. It is to be hoped however that the industry may be revived, and the Department has employed the waiting period in carrying on experiments to furnish information on the vital points referred to above. A preliminary report on the experiments begun in May 1915 has already been published (*Bulletin* XVI. 1917, 18-20). A second report is included in this issue (pp. 193-8). In this Mr. de Verteuil shows that there is, as was anticipated, a large variation in the yields of local varieties, and that the 8 tons of roots per acre is obtainable from the better varieties. Of special interest are the records of yield of roots and starch per acre from plants of known age, from which the conclusions are drawn that under the conditions at St. Augustine the maximum return per acre is obtained by reaping cassava during the dry season, and apparently when not less than 16 to 17 months of age. Further experiments are being made.

Strongylus.—Strongylus is the name usually employed in the Colony to denote the diseases of cattle, goats, sheep, &c., due to attacks of parasitic worms. These may be present in the stomach and intestines, or in the lungs. How important are this group of parasites will be seen from the table on p 207 in which Mr. McInroy shows that of 624 deaths

at the Government Farms Trinidad and Tobago in the 21 years 1896 to 1917, no less than 342 were due to *Strongylus*, and 115 more to other diseases now suspected as being primarily due to *Strongylus* but particularly in the earlier years put down to other causes. The notes by Messrs. McInroy and Meaden are prefaced by some very valuable information from Dr. Ranson, Chief of the Zoological Division, Bureau of Animal Industry, U. S. Department of Agriculture, who has devoted special attention to this group.

The Mongoose.—The paper by Mr. C. B. Williams (pp. 167–86) of this issue provides fuller knowledge than has hitherto been available of the actual food of the mongoose in Trinidad and allows more reliable conclusions being drawn regarding the responsibilities of the mongoose as a cause of the abundance of the frog hopper. The results of his investigation lead him to regard the mongoose in this connection as neither entirely harmful, as is so often assumed, nor entirely beneficial. As shown in the balance sheet on page 181, the complete extermination of the mongoose in Trinidad would probably result in an increase in the number of lizards, frogs and toads, but also of rats. The damage done to wild birds by the mongoose is regarded as probably completely offset by the number of rats destroyed, which would themselves have destroyed tree-inhabiting birds beyond the reach of the mongoose. In other than limited numbers on a Trinidad estate the mongoose is undesirable, and this is best secured by the practice of paying a reward for their capture as when they reach the point at which they are not harmful, they will be too scarce to make their capture remunerative.

Shortly after Mr. Williams paper was sent in for publication the *Agricultural News* of November 2, 1918 was received with an interesting article on "Rats and Mongoose in the West Indies," which is here reproduced, as also our recent Mongoose Ordinance.

Produce Taxes, 1919.—The following are the rates of taxes on produce to be levied in 1919, under Ordinance 28 of 1918. The taxes "in aid of agriculture" form the revenue of the Board of Agriculture and their rates have been fixed so as to bring in an estimated yield of about £3,000.

	<i>General Revenue.</i>		<i>In aid of Agriculture.</i>	
	s.	d.	s.	d.
Sugar (for every 1,000 lb.) ...	2	0	...	8
Rum (for every gallon) ...	2		...	Nil.
Molasses (for every gallon) ...		0½	...	Nil.
Cacao (for every 100 lb.) ...		7	...	0½
Coconuts (for every 1,000 nuts) ...	5	0	...	1½
Copra (for every 1,000 lb.) ...	16	8	...	4
Cedar (for every cubic foot) ...	2		...	Nil.

W. G. FREEMAN.

MONGOOSE.

THE FOOD OF THE MONGOOSE IN TRINIDAD.

By C. B. WILLIAMS, M.A., F.E.S.,
Entomologist in Charge of Froghopper Investigations.

INTRODUCTION.

During the course of the various investigations that have been carried on in this island of recent years into the control of the Sugar-cane Froghopper (*Tomaspis saccharina*), the question of the responsibility of the mongoose as a cause of the abundance of this insect has frequently been raised.

It has been claimed by some that the advent of the series of plagues of froghoppers during recent years has followed closely on the spread of the mongoose. Others state that the scarcity of birds and lizards in the cane fields is caused by the depredations of the same animal. A smaller number hold, with if anything less evidence, that there is no connection between the two and that the recent wholesale destruction of the mongoose is a mistaken policy.

As no reliable conclusion could be drawn without accurate and complete knowledge of the food of the mongoose, a search was made through the available literature for such information, when it rapidly became obvious that the greater part of the evidence consisted either of hearsay, or of certain obvious facts repeated so incessantly as to give them an entirely false weight in the argument.

The only certain method of obtaining a knowledge of the food of an animal consists in an examination of the stomach contents, and the results of only two such investigations could be found.

Between 1900 and 1903 the Rev. M. Watson of Barbados examined the contents of 59 stomachs and the following summary was published (*Agricultural News, Barbados II, 1903, 261*):—

Toads (with beetles in their stomachs)...	in 15 stomachs.	
Green lizards	7	} Total of birds in 12 stomachs.
Ground lizards	1 stomach.	
Blackbirds	7 stomachs.	
Ground doves	4	
Small yellow bird	1 stomach.	
Centipedes	6 stomachs.	

In 1917 Mr. F. W. Urich gave the results of the examination of 149 stomachs made at Waterloo Estate, Trinidad, between December 27, 1916 and February 10, 1917 (Minutes of the Board of Agriculture, Trinidad 1917, No. 7, p. 31). These were summarised as follows:—

Birds feathers ... ..	..	..	.. in 8 stomachs.
Toads ... ..	...	...	.. " 33 "
Lizards ... ..	...	...	.. " 9 "
Mice and rats ... ..	...	...	.. " 11 "
Snakes ... ..	...	...	.. " 4 "
Fish ... ..	...	...	.. " 34 "
Egg shells ... ..	...	...	.. " 1 stomach.
Insects ... ..	...	...	.. " 63 stomachs.
Crabs ... ..	...	...	.. " 10 "
Empty ... ..	...	...	.. 28 "

It might perhaps be instructive to note that this investigation, the first of its kind to be made in Trinidad, was started forty-seven years after the original introduction of the mongoose (about 1870), and fifteen years after it had been assumed to be a pest of sufficient importance to warrant a government reward for its destruction.

It was evident on examination that the above records were insufficient evidence on which to base a reliable opinion; the former on account of its brevity and obvious incompleteness (no insects are mentioned except a few beetles which are assumed to come from the stomachs of the toads); the latter chiefly because all the dissections were made in six weeks and no allowance could be made for possible seasonal variation.

In order to provide the necessary information dissections were started in October, 1917, and were carried on as fully as possible until September, 1918. In all 180 stomachs were examined of which 14 were empty. Of the remaining 166, 85 were obtained in the dry season (February to May) and 81 in the wet season (June to January). January, 1918 was exceptionally wet.

STOMACH CONTENTS.

OCTOBER 1917

1. (Caroni, Sugar Estate).
Grasshoppers (*Acridiidae*), cockroaches, "hardback" beetles (*Melolonthidae*), spider, small piece of grass.
2. (Caroni, Sugar Estate).
Skin of frog; grub of beetle (? *Lamellicorn*); spider.
3. (Caroni, Sugar Estate).
Empty.
4. (Caroni, Sugar Estate).
1 lizard; 3 or 4 grasshoppers; 1 cockroach; 3 beetle grubs; one or more spiders; a little grass.
5. (Caroni, Sugar Estate).
1 cockroach; 1 "hard back" beetle; 1 legless beetle grub; 1 large hairy spider; small pieces of vegetation.
6. (Caroni, Sugar Estate).
Empty.
7. (Cumana Valley, Cacao Estate).
1 small snake; 1 large and 1 small green grasshoppers (*Locustidae*); many smaller grasshoppers (*Acridiidae*); several cockroaches; 2 predaceous beetle grubs (*Carabidae*); 1 hairy spider; 1 small centipede.
8. (Cumana Valley, Cacao Estate).
2 grasshoppers; 1 cockroach; some other insect remains; small pieces of grass.
9. (Cumana Valley, Cacao Estate).
Many grasshoppers, 1 cockroach.
10. (Cumana Valley, Cacao Estate).
3 or 4 grasshoppers; 1 cockroach; 1 small beetle.
11. (Cumana Valley, Cacao Estate).
1 large and several smaller grasshoppers (*Acridiidae*), 1 cockroach; 1 black *Lamellicorn* beetle.
12. (Cumana Valley, Cacao Estate).
Several grasshoppers; 1 beetle grub (*Elaterid*); 2 fly maggots (*Diptera*); 2 hairy spiders.

13. (Caroni, Sugar Estate).
1 small lizard; several hardbacks (*Melolonthidæ*); 1 black weevil (*Metanastus*); 1 spider.
14. (Caroni, Sugar Estate).
Yellow mass of vegetable matter—? yam or banana.
15. (Caroni, Sugar Estate).
1 small lizard; 1 small frog; 1 hardback beetle; 1 grasshopper;
2 large hairy spiders.
16. (Caroni, Sugar Estate).
Several grasshoppers; 1 caterpillar; 1 centipede.
17. (Caroni, Sugar Estate).
A few mongoose hairs (classed as empty).
18. (Caroni, Sugar Estate).
1 small snake (? *Streptophonus atratus*); 1 grasshopper.

NOVEMBER 1917.

19. (Caroni, Sugar Estate).
1 small lizard; 1 small snake (? *S. atratus*); several grasshoppers;
1 spider; 1 centipede.
20. (Caroni, Sugar Estate).
1 small frog; several grasshoppers; 1 cockroach; 6 weevil grubs
(? *Metamasius hemipterus*); 1 beetle, a few small leaves.
21. (Caroni, Sugar Estate).
1 weevil grub (? *Metamasius*); 1 spider.
22. (Caroni, Sugar Estate).
1 large hairy spider.
23. (Caroni, Sugar Estate).
1 frog; several grasshoppers; 1 beetle; 3 or more spiders.
24. (Woodford Lodge, Sugar Estate).
1 small snake; 2 grasshoppers; 1 cockroach; 1 beetle; 2 fly grubs
(*Diptera*); seeds and pulp of some unidentified fruit.
25. (St. Clair, Outskirts of Town).
1 grasshopper; 1 cockroach; 1 small beetle.
26. (Cumana Valley, Cacao Estate).
3 down feathers of Bird; several grasshoppers.
27. (Cumana Valley, Cacao Estate).
Slight vegetable remains; a few mongoose hairs.
28. (Breachin Castle, Sugar Estate).
1 grasshopper.
29. (Breachin Castle, Sugar Estate).
1 large toad; 5 or 6 large and small grasshoppers; 1 mole cricket;
1 cockroach.
30. (St. Clair, Outskirts of town).
1 large lizard; 1 grasshopper; 1 cricket.

DECEMBER 1917.

31. (St. Clair, Outskirts of town).
1 small snake; 4 grasshoppers; 1 Carabid beetle grub; 2 other
beetle grubs; 1 large hairy spider.
32. (La Fortune, San Fernando, Sugar Estate)
1 rat; 2 grasshoppers.

JANUARY 1918.

33. (Caroni, Sugar Estate).
Several small and one large grasshoppers; 1 black Lamellicorn
beetle; 1 small Phytophagous beetle.
34. (Caroni, Sugar Estate).
1 cockroach; 1 large centipede; grass.

35. (Caroni, Sugar Estate).
1 small frog; 1 grasshopper.
36. (Caroni, Sugar Estate).
1 small piece of skin of snake; several grasshoppers; 1 large centipede; 1 large hairy spider.
37. (Caroni, Sugar Estate).
Mongoose hairs; 1 frog; several grasshoppers; 1 mole cricket; 1 black weevil (? *Metamasius*); 1 green leaf.
38. (Caroni, Sugar Estate).
Many grasshoppers, 1 cockroach, 1 small beetle, 1 large centipede, 1 large hairy spider.

FEBRUARY 1918.

39. (Cumana Valley, Cacao Estate).
Feathers and feet of small bird (domestic fowl?); 6 fly grubs (? from stomach of bird); 1 small beetle; 1 grasshopper.
40. (Cumana Valley, Cacao Estate).
Several bird feathers; several grasshoppers; 1 hardback beetle; 2 small fly grubs.
41. (Cumana Valley, Cacao Estate).
Empty.
42. (Cumana Valley, Cacao Estate).
1 foot of bird, domestic fowl; 1 grasshopper; 1 large centipede.
43. (Breachin Castle, Sugar Estate).
Flesh of bird or mammal (no hairs or feathers); 3 or 4 grasshoppers; 1 predaceous beetle grub (*Carabidæ*); 1 cockroach.
44. (Waterloo, Sugar Estate).
2 large beetle grubs (*Lamellicorn*); 1 grasshopper.
45. (Waterloo, Sugar Estate).
6 grasshoppers; 1 cockroach; 2 predaceous beetle grubs (*Carabidæ*, *Encilades*?); 2 Elaterid beetles; 1 small phytophagous beetle; 2 seeds and some green leaves.
46. (Waterloo, Sugar Estate).
5 or 6 grasshoppers; 1 hairy spider.
47. (Waterloo, Sugar Estate).
2 grasshoppers; 1 cockroach.

MARCH 1918.

48. (Harmony Hall, Sugar Estate).
3 or 4 grasshoppers; 1 small phytophagous beetle; a little grass.
49. (Harmony Hall, Sugar Estate).
1 small frog; 2 large and 6 or 8 small grasshoppers; 1 cockroach; 1 predaceous beetle grub (*Carabidæ*); 1 plant bug (*Pentatomidæ*); 1 large spider; 1 small millipede.
50. (Harmony Hall, Sugar Estate).
2 grasshoppers; vegetable matter—? fruit.
51. (Capaxo, Cacao Estate).
1 lizard: a few feathers of bird; 3 grasshoppers; 1 predaceous beetle grub (*Carabidæ*—*Encilades*).
52. (Harmony Hall, Sugar Estate).
Empty.
53. (Harmony Hall, Sugar Estate).
Hairs of 'Spiney Hat' (? *Ecimys trinitatis*); 2 or 3 grasshoppers; 1 moth; a predaceous beetle grub (*Carabidæ*).
54. (St. Clair, Outskirts of Town).
Flesh of some animal, no hairs or feathers; 3 or 4 grasshoppers.
55. (La Fortunée, Sugar Estate).
1 crab; 2 grasshoppers; 1 predaceous beetle grub (*Carabidæ*).

56. (Harmony Hall, Sugar Estate).
6 or 7 grasshoppers; 1 moth.
 57. (Harmony Hall, Sugar Estate).
1 small snake; 1 small lizard; 7 or 8 grasshoppers.
 58. (Harmony Hall, Sugar Estate).
1 rat; several grasshoppers; 1 predaceous beetle grub (*Carabidæ*).
 59. (Harmony Hall, Sugar Estate).
1 large grasshopper.
 60. (Harmony Hall, Sugar Estate).
1 bird—down feathers and flesh; 4 large grasshoppers.
 61. (Harmony Hall, Sugar Estate).
1 rat; 1 grasshopper.
 62. (Harmony Hall, Sugar Estate).
1 bird (feathers and stomach containing seeds); about a dozen grasshoppers; a large black Lamellicorn beetle.
 63. (Waterloo, Sugar Estate).
1 toad; 1 hairy spider.
 64. (Waterloo, Sugar Estate).
1 rat; 2 grasshoppers.
 65. (Waterloo, Sugar Estate).
1 fish; 1 rat; several mongoose hairs; 12 grasshoppers; 1 cockroach; 1 small beetle.
 66. (Waterloo, Sugar Estate).
1 small lizard; many grasshoppers; 3 predaceous beetle grubs (*Carabidæ*); 1 spider.
 67. (Waterloo, Sugar Estate).
1 rat.
 68. (Waterloo, Sugar Estate).
1 lizard; several grasshoppers; 1 beetle.
- APRIL 1918.
69. (Cumana Valley, Cacao Estate).
Empty.
 70. (Cumana Valley, Cacao Estate).
1 fish; 1 grasshopper.
 71. (Cumana Valley, Cacao Estate).
1 bird—domestic fowl; 1 small snake; several grasshoppers; 1 hairy spider.
 72. (Cumana Valley, Cacao Estate).
Several grasshoppers; 1 cockroach; 1 small cricket; 1 stuck insect (*Phasmidæ*); 1 large hairy spider.
 73. (Waterloo, Sugar Estate).
2 grasshoppers.
 74. (Waterloo, Sugar Estate).
Vegetable matter.
 75. (Caparo, Cacao Estate).
1 grasshopper; 1 cockroach; 1 beetle; 1 spider; fruit pulp.
 76. (Caparo, Cacao Estate).
1 lizard; 1 grasshopper; 1 large spider; fruit pulp and skin.
 77. (Caparo, Cacao Estate).
1 grasshopper; 1 cockroach; 3 predaceous beetle grubs; 1 large hairy spider.
 78. (Caparo, Cacao Estate).
1 bird (feathers); 2 grasshoppers; 1 cockroach; 1 predaceous beetle grub (*Carabidæ*).
 79. (Waterloo, Sugar Estate).
1 bird—foot and claws (? domestic fowl).

90. (Waterloo, Sugar Estate).
Traces of vegetable matter.
91. (Waterloo, Sugar Estate).
Several grasshoppers; little vegetable matter.
92. (Waterloo, Sugar Estate).
1 grasshopper; 1 beetle; little grass.
93. (Waterloo, Sugar Estate).
1 large spider.
94. (Waterloo, Sugar Estate).
2 grasshoppers; 1 Lamellicorn beetle.
95. (Waterloo, Sugar Estate).
Empty.
96. (Waterloo, Sugar Estate).
Empty.
97. (Waterloo, Sugar Estate).
1 grasshopper; 1 beetle.
98. (Waterloo, Sugar Estate).
Several grasshoppers; little grass.
99. (Waterloo, Sugar Estate).
1 frog; many grasshoppers; 1 cockroach; 1 predaceous beetle grub (*Carabidæ*).
100. (Waterloo, Sugar Estate).
1 lizard; 1 fish; 1 grasshopper; 1 beetle.
101. (Waterloo, Sugar Estate).
1 young rat; 1 grasshopper; 1 predaceous beetle grub; 1 spider.
102. (Waterloo, Sugar Estate).
Fish; 1 grasshopper.
103. (Waterloo, Sugar Estate).
Many grasshoppers (10-15); 3 fly grubs (*Diptera*); 1 cockroach.
104. (Waterloo, Sugar Estate).
15 grasshoppers; 1 cockroach.
105. (Waterloo, Sugar Estate).
1 rat; 1 grasshopper.
106. (Waterloo, Sugar Estate).
1 lizard; 6 grasshoppers; 1 cockroach; 1 beetle.
107. (Caparo, Cacao Estate).
1 fish; 1 lizard (? *Scolecusaurus cuvieri*); many grasshoppers;
1 predaceous beetle grub (*Carabidæ*); 1 cockroach.
108. (Caparo, Cacao Estate).
Fruit.
109. (Caparo, Cacao Estate).
3 grasshoppers; 1 cockroach.
110. (Caparo, Cacao Estate).
1 spiny rat (? *Ecimys trinitatis*); vegetable matter.
111. (California, Sugar Estate).
1 rat; 1 small snake; 1 large grasshopper; 1 cockroach; 2 predaceous beetle grubs (*Carabidæ*); 1 crab (leg),
112. (California, Sugar Estate).
1 rat; 1 small snake; 3 or 4 grasshoppers; vegetable matter
(? coconut).
113. (Craignish, Sugar Estate).
1 ? rat; 1 grasshopper; 1 beetle.
114. (Harmony Hall, Sugar Estate).
1 rat; 1 small frog; several grasshoppers; 3 predaceous beetle grubs; 1 small scorpion.

105. (Harmony Hall, Sugar Estate).
1 rat (fur).
106. (Harmony Hall, Sugar Estate).
1 toad; 1 grasshopper; several small beetles, 1 cockroach; 5 fly grubs; (N. B.—Some of these might be from stomach of toad).
107. (Harmony Hall, Sugar Estate).
1 rat; 1 bird (feathers and flesh), several grasshoppers; 4 fly grubs; 2 beetles; 1 spider.
108. (Harmony Hall, Sugar Estate).
1 grasshopper; 1 beetle.
109. (Cumana Valley, Cacao Estate).
1 bird (domestic fowl).
110. (Cumana Valley, Cacao Estate).
1 lizard; 4 grasshoppers; 1 spider.
111. (Cumana Valley, Cacao Estate).
Empty.

MAY, 1918.

112. (St. Clair, Outskirts of town).
3 grasshoppers; 4 large Lamellicorn beetles.
113. (Cumana Valley, Cacao Estate).
1 bird—domestic fowl; 1 grasshopper.
114. (Cumana Valley, Cacao Estate).
Empty.
115. (Cumana Valley, Cacao Estate).
1 small frog; 3 grasshoppers; 1 beetle.
116. (Cumana Valley, Cacao Estate).
Meat; 1 grasshopper; 1 black Lamellicorn beetle.
117. (Brechtin Castle, Sugar Estate).
1 toad; several grasshoppers; 1 predaceous beetle grub, 1 tick (from the toad).
118. (Waterloo, Sugar Estate).
1 small rat; 1 ant; 1 beetle grub (Lamellicorn).
119. (Waterloo, Sugar Estate).
1 rat; 4 grasshoppers; 1 cockroach.
120. (Caroni, Sugar Estate).
15 grasshoppers; 1 beetle; grass.
121. (Caroni, Sugar Estate).
1 large toad; 1 large and 8 smaller grasshoppers; 1 cockroach; 1 beetle.
122. (Caroni, Sugar Estate).
1 rat; 1 frog; 1 large and 2 smaller grasshoppers; 1 cockroach.
123. (Reform, Sugar Estate).
3 grasshoppers; 1 small beetle; 1 predaceous beetle grub; 1 large spider.
124. (Reform, Sugar Estate).
1 rat; 6 grasshoppers; 1 large black "hardback" beetle (*Melolonthidæ*); 3 predaceous beetle grubs (*Carabidæ*).
125. (Reform, Sugar Estate).
1 toad; 6 grasshoppers; 1 brown weevil (*Metamasius*); 1 fly grub (? from stomach of toad).
126. (Reform, Sugar Estate).
1 rat; 1 grasshopper.
127. (Reform, Sugar Estate).
1 toad; 12 grasshoppers; 1 cockroach; 1 large black "hardback.
128. (Reform, Sugar Estate).
1 lizard.

129. (Reform, Sugar Estate).
1 egg of domestic fowl; 10 grasshoppers; 1 cockroach; 2 predaceous beetle grubs (*Carabidæ*).
130. (Reform, Sugar Estate).
6 grasshoppers: 2 predaceous beetle grubs (*Carabidæ*).

JUNE 1918.

131. (La Fortunée, Sugar Estate).
1 frog; 1 bird; 1 grasshopper; 1 beetle; 1 moth (? from stomach of toad).
132. (Brechin Castle, Sugar Estate).
A few mongoose hairs (recorded as empty).
133. (Caparo, Cacao Estate).
1 snake; 1 toad; several grasshoppers; 3 predaceous beetle grubs (*Carabidæ*); 3 black Lamellicorn beetles;
134. (Brechin Castle, Sugar Estate).
1 small beetle; 1 cockroach.
135. (Caroni, Sugar Estate).
1 large toad; 1 grasshopper.
136. (Caroni, Sugar Estate).
1 toad; 1 grasshopper.
137. (Caroni, Sugar Estate).
Empty.
138. (Caroni, Sugar Estate).
1 small snake (*Streptophonus atratus*); 3 grasshoppers.
139. (Caroni, Sugar Estate).
6 grasshoppers; 1 cockroach: 1 Lamellicorn beetle.
140. (Caroni, Sugar Estate).
5 grasshoppers; 1 cockroach; 1 hardback beetle (*Melolonthidæ*); 2 black weevils (*Metamasius*).
141. (Caroni, Sugar Estate).
1 snake (*Streptophonus atratus*); 6 grasshoppers; 1 cockroach; 1 cricket.
142. (Caparo, Cacao Estate).
1 toad; 3 Lamellicorn beetles; 1 predaceous beetle grub (*Carabidæ*); 1 brown weevil (*Metamasius*); 1 small spider (last two probably from stomach of toad).
143. (Caparo, Cacao Estate).
1 grasshopper; 1 predaceous beetle grub (*Carabidæ*); several beetles; pulp of fruit.
144. (Caparo, Cacao Estate).
1 bird; 1 small snake; 1 Lamellicorn beetle; 1 large spider; pulp of fruit.
145. (Caparo, Cacao Estate).
1 small snake; 5 large grasshoppers; 1 cockroach; 1 black Lamellicorn beetle; 1 predaceous beetle grub (*Carabidæ*).
146. (Caparo, Cacao Estate).
1 snake—*Lophis melanotus* (eats frogs and lizards); 1 bird; 3 grasshoppers; 2 large black Lamellicorn beetles; 1 predaceous beetle grub (*Carabidæ*).
147. (Caparo, Cacao Estate).
1 rat; 1 grasshopper.
148. (Caparo, Cacao Estate).
2 grasshoppers; 4 large black Lamellicorn beetles; 1 predaceous beetle grub.

JULY 1918.

149. (La Fortunée, Sugar Estate).
2 grasshoppers; 1 cockroach.

150. (La Fortuneé, Sugar Estate).
1 bird (foot bones only).
151. (Biechin Castle, Sugar Estate).
1 toad; 3 grasshoppers; 1 cockroach; vegetable matter.
152. (Biechin Castle, Sugar Estate).
1 rat; 1 lizard; 1 grasshopper; 2 "hardback" beetles (*Melolonthidæ*).
153. (Biechin Castle, Sugar Estate).
Egg of domestic fowl; 6 grasshoppers; 1 "hardback" beetle (*Melolonthidæ*).
154. (Cumana Valley, Cacao Estate).
1 small snake; 1 bird claw (domestic fowl), 1 grasshopper; 1 large centipede.

AUGUST 1918.

155. (Cumana Valley, Cacao Estate).
1 lizard, 3 grasshoppers; 1 large spider; 1 large centipede.
156. (Cumana Valley, Cacao Estate).
2 grasshoppers; traces of vegetable matter.
157. (Cumana Valley, Cacao Estate).
1 bird (domestic fowl); 1 grasshopper; 1 "hardback" beetle (*Melolonthidæ*).
158. (Cumana Valley, Cacao Estate).
1 large centipede.
159. (Cumana Valley, Cacao Estate).
Empty.
160. (San Fernando—Outskirts of town).
Several feathers of bird (? domestic fowl); 3 fly grubs (*Diptera*).
161. (San Fernando—Outskirts of town).
1 domestic fowl; 1 rat, 1 snake; 1 grasshopper; 1 beetle; 1 large centipede.
162. (Reform, Sugar Estate).
2 grasshoppers, 1 cockroach.
163. (Williamsville, Sugar Estate).
1 piece of grass.
164. (Williamsville, Sugar Estate).
4 grasshoppers, 1 cockroach; 1 spider; 1 centipede.

SEPTEMBER 1918.

165. (La Fortuneé, Sugar Estate).
Empty.
166. (Caroni Sugar Estate).
1 rat; 1 crab; 2 grasshoppers.
167. (Caroni, Sugar Estate).
1 frog; 1 large green grasshopper (*Locustidæ*), 1 Lamellicorn beetle, 1 spider.
168. (Caroni, Sugar Estate).
1 frog; 1 piece of grass.
169. (Caroni, Sugar Estate).
4 grasshoppers; 1 centipede.
170. (Caroni Sugar Estate).
3 grasshoppers; 1 large spider; fruit with small brown seeds.
171. (Caroni, Sugar Estate).
1 fish; 6 grasshoppers; 1 large spider.
172. (Caroni, Sugar Estate).
4 grasshoppers; 1 spider; 1 large centipede.
173. (La Fortuneé, Sugar Estate).
1 rat.

174. (Wellington, Sugar Estate).
1 bird; 1 toad; 6 grasshoppers; 1 cockroach; 4 "hardback" beetles (*Melolonthidæ*).
175. (Wellington, Sugar Estate).
1 bird; 1 rat; 2 or 3 grasshoppers; 2 ants (? from stomach of bird).
176. (Wellington, Sugar Estate).
1 bird; 1 toad; 4 grasshoppers; 1 cockroach; 2 Lamellicorn beetles.
177. (Wellington, Sugar Estate).
1 bird; 1 large green grasshopper (*Locustidæ*); 4 grasshoppers (*Acrididæ*); 1 plant bug (*Pentatomidæ*); 1 small beetle (? last two from stomach of bird).
178. (Wellington, Sugar Estate).
1 rat; 1 bird; 2 grasshoppers; 1 cockroach; 1 predaceous beetle grub (*Carabidæ*); 1 caterpillar.
179. (Wellington, Sugar Estate).
1 large green grasshopper (*Locustidæ*); 4 grasshoppers (*Acrididæ*); 1 cockroach.
180. (Caroni, Sugar Estate).
1 frog; 7 grasshoppers; 2 cockroaches; 1 spider.

REMARKS ON THE VARIOUS FOODS.

VERTEBRATES.

RATS.—As is well known, the mongoose was originally introduced into the West Indies in order to destroy the rats which did serious damage to sugar cane. In 1882 Morris estimated that the mongoose, then introduced for about ten years, had saved the planters of Jamaica nearly £45,000 per annum by the destruction of rats (D. Morris, *The Mongoose on Sugar Estates in the West Indies*. Kingston, Jamaica 1882 p. 12). It will be seen that rats still form an appreciable part of its food. An increase in the number of rats must be expected after any wholesale destruction of the mongoose. The "Spiney Rat" (*Ecimys trinitatis*?), which was found twice in the stomachs, is a somewhat rare species, the habits of which are little known; it can easily be recognised in the stomach contents by the flat sword-like form of the hairs. In addition to feeding on sugar-cane rats can climb and are known to destroy the eggs of tree-nesting birds.

BIRDS.—Of the twenty-four birds found in the stomachs, ten were almost certainly domestic fowls and several others may also have been so. The mongoose is generally said to be a great enemy of ground birds, yet two of the commonest birds on sugar estates are the ground doves (*Egyptia rufaxilla* and *E. verreauxi*), and the small black finch or cici-zebe (*Volatina jacarina*) both of which nest on or near the ground.

It has been said that the mongoose sucks the blood of a bird without eating the feathers and that on this account a stomach examination is not always reliable. In the stomachs examined the feathers found were usually, but not always, down-feathers and this seems to lend some support to the statement that the mongoose does not eat the whole bird. At the same time it seems unlikely that it would be able to kill and suck a bird without swallowing at least a few down-feathers and as

in the above dissections the presence of a single feather has been taken as evidence of the destruction of a bird, the numbers given are probably not far from correct.

BIRDS' EGGS.—At first I was doubtful as the possibility of recognising the remains of eggs in the stomach contents, but the two found (129 and 153) were so obvious that it is doubtful if any were missed. Both were eggs of the domestic fowl and as this is sometimes used to bait the mongoose traps, it may have been so in these cases. The present dissections give little support to the statement that the mongoose destroys large numbers of eggs of wild birds. In any case the nests of the trees and bush inhabiting birds are out of its reach while they are frequently destroyed by rats, so that the mongoose may save a larger number of these birds by destroying the rats, than it kills itself directly.

LIZARDS.—In the absence of a working collection of the Trinidad lizards, and on account of the fragmentary remains often found, it was usually impossible to identify the species concerned. For purposes of argument it will be assumed that all lizards are beneficial, though it might be pointed out that no accurate investigation of their food has yet been carried out, and that, although mainly insectivorous, they probably destroy useful as well as injurious insects.

SNAKES.—The remarks on lizards apply in general here also. Only two species have been doubtfully identified. *Lophis melanotus*, locally known as "Beh Belle Chemin" and said to feed on frogs and lizards, and *Streptophorus atratus*, said to eat insects and earthworms. The destruction of snakes by the mongoose in Trinidad probably has little effect one way or the other on the planter. In countries where poisonous snakes are common their destruction must be put to the credit of the mongoose.

FROGS AND TOADS occur in twenty-nine stomachs. For want of more accurate knowledge they are assumed to be entirely beneficial. It might be pointed out here that better drainage of the cane fields and the prevention of small pools of standing water may be a serious contributory cause in the reduction of these animals on an estate.

FISH.—In six cases fish remains were found. This small number contrasts curiously with the numbers obtained at Waterloo Estate, which were 34 out of 149 stomachs (see p.). In any case the food is of no consequence from an agricultural point of view.

ARTHOPODS.

It is worthy of notice that in 56 out of the 166 stomachs which contained food, that is in 33 per cent., the animal food was entirely Arthropod (insects, spiders, centipede, etc.)

GRASSHOPPERS.—These make up a very large proportion of the total food of the mongoose. They occurred in 136 out of the 166 stomachs containing food. The short-horned grasshoppers (*Aceridiidae*) greatly

outnumbered the long-horned green-grasshoppers or 'katydids' (*Locustidae*). The commonest species was a large Acridiid with a red body, which was conspicuous in the stomach contents. For purposes of argument the grasshoppers will be assumed to be injurious, though it may be pointed out that those which confine their attention to wild grasses in the cane fields may be actually beneficial. *Xiphidium* sp. a small predacious Locustid very abundant along the traces in the cane fields was not noted in the stomachs.

CRICKETS (*Gryllidae*).—These are generally injurious in the cane fields but the numbers found were insufficient to be of any consequence.

COCKROACHES form a distinct part of the food; the insect is not the common house cockroach but a smaller field species at present unidentified. Too little is known of their habits to say if they should be considered useful or injurious.

STICK-INSECTS (*Phasmodae*).—The egg of a stick-insect was found among the contents of one stomach (No. 72). They had probably come from the body of an adult insect eaten and digested.

MOTHS AND CATERPILLARS.—These occur too seldom to be of any practical importance. In one case (No. 131) the remains of a toad was found in the same stomach so that the moth might have come from the stomach of this animal. In the other two cases of adult moths (Nos. 58 and 56) both of which were fairly large species, there was nothing to indicate that they had not been eaten by the mongoose.

FLY GRUBS (*Diptera*) occurred in nine stomachs. In six of these (Nos. 39, 40, 106, 107, 125, and 160) there were present also the remains of toads or birds from the stomachs of which they might have come. In the other cases (12, 24, 98) there was no such evidence. They were much below the average size of insect taken by the mongoose but may be eaten occasionally.

PLANT BUGS (*Pentatomidae*) were found in two stomachs. The first of these was a large species probably eaten by the mongoose (in spite of its strong smell), the second (No. 177) was a much smaller species which might have come from the stomach of a bird also present.

LAMELLICORN BEETLES AND THEIR GRUBS.—The group of Lamellicorn beetles includes those commonly known as 'hardbacks' or 'white grubs' (*Melolonthidae*) and other large species such as the 'rhinoceros beetles.' Nearly all are injurious to crops and the mongoose is doing good work on a limited scale in destroying them.

CARABID BEETLE GRUBS.—These occur in unexpected numbers in the stomachs. They are predaceous insets and, in the absence of exact knowledge of their food, may be classed as probably useful.

WEEVILS (*Rhynchophora* including undoubted *Metamasius hemipterus*, the 'weevil borer' of sugar cane, were found in the stomachs.

Their total numbers were however insufficient to be of any serious importance.

MISCELLANEOUS BEETLES.—A number of smaller beetles, chiefly plant-eating species, were found in the stomachs. Some may have been from the stomachs of other prey. In any case they are of little practical importance.

ANTS were found in two stomachs, in one of which (No. 175) there was also the remains of a bird from the stomach of which they might have come.

SPIDERS.—In no previous record of the food of the mongoose have spiders been mentioned. From the above results it will be seen that they form quite an appreciable part of the food. Their remains were found in thirty-eight stomachs. The species was almost without exception a large long-legged slightly hairy ground-spider at present, unidentified. (1) In one of the exceptional cases in which a smaller species occurred (No. 142) it might have come from the stomach of a toad which was also present.

SCORPION.—One small specimen only was found in stomach No. 104. Its presence was decidedly unexpected.

CENTIPEDES.—A large greenish species reaching apparently up to about seven or eight inches in length, formed an appreciable part of the food, occurring in fourteen stomachs. It has been noted above that Watson found them in six out of fifty-nine stomachs in Barbados.

MILLIPEDE.—A single small specimen was found in stomach No. 49.

TICKS.—A single specimen was found in stomach No. 117 together with the remains of a toad to which it was undoubtedly attached when swallowed.

CRABS.—Remains of land-crabs were found in only three stomachs. They are on the whole injurious to sugar estates.

VEGETABLE MATTER.

Vegetable matter with very few exceptions consisted only of small scraps of grass or leaves such as might easily have been accidentally swallowed along with other prey. The chief exceptions were: No. 14, which contained only vegetable matter, No. 102 which contained coconut, and Nos. 75, 76, 98, 143 and 144 (all from one locality) which contained the remains of some unidentified fruit. Banana is sometimes used successfully as a bait for mongoose traps.

BALANCE SHEET.

Bearing in mind the above remarks and qualifications it will be possible to make an estimate of the total food of the mongoose and to prepare from that a balance sheet showing on the one hand the damage, and on the other the good, that it does.

(1.) Recently determined as *Ctenus* sp. (Family *Clubionidae*).

The total contents of the above 180 stomachs might be considered as the contents of a single stomach during 180 successive periods of uncertain length, approximating to the length of time taken from the moment food is eaten to the moment it is passed from the stomach. Without affecting the results, this might be assumed as half a day. The 180 successive periods will then total approximately 90 days or about three months.

We then get the following total food for a single mongoose for a period of three months (Table I). All the useful animals destroyed are printed in CAPITALS, all the injurious animals in *Italics*.

TABLE I.—TOTAL FOOD OF A MONGOOSE IN ABOUT THREE MONTHS.

Vertebrates	— <i>Common Rat</i>	26
	<i>Spiney Rat</i>	2
	MISCELLANEOUS BIRDS	14
	DOMESTIC FOWL	10
	FOWL EGGS	2
	LIZARDS	17
	Snakes	18
	FROGS	15
	TOADS	14
	Fish	6
Insects	— <i>Grasshoppers</i>	535
	<i>Mole-crickets</i>	2
	<i>Crickets</i>	3
	Cockroaches	54
	<i>Stick Insects</i>	1
	<i>Moths</i>	3
	<i>Caterpillars</i>	2
	Fly-grubs	27
	<i>Plant Bugs</i>	2
	<i>Lamellicorn Beetles</i>	43
	<i>Lamellicorn Grubs</i>	7
	CARABID GRUBS... ..	44
	<i>Weevils, adults</i>	7
	<i>Weevils, grubs</i>	7
	Miscellaneous Beetles	46
	Ants	3
Other Arthropods—	SPIDERS	14
	Scorpion	1
	Centipedes	14
	Millipede	1
	Tick	1
	<i>Crab</i>	3
Vegetable Matter—Half a dozen fruits.		
One feed of Yam.		
A little Coconut.		

Leaving out these foods which are of no practical importance we obtain the following balance sheet for the mongoose:—

TABLE II.—BALANCE SHEET.

<i>Credit.</i>	<i>Debit.</i>
28 Rats.	26 Birds.
About 600 injurious insects.	17 Lizards.
8 Crabs.	29 Frogs and Toads.
	44 Useful insects.
	44 Spiders.

From this table it is possible to draw certain conclusions of which the following are perhaps the most important:—

- (i.) The mongoose is neither entirely harmful, nor on the other hand entirely beneficial.
- (ii.) The damage done to wild birds is probably completely offset by the number of rats destroyed, which would themselves have destroyed many of the tree-living birds which the mongoose cannot reach.
- (iii.) The destruction of lizards and frogs and toads is only partly offset by the numbers of injurious insects destroyed, and there is little doubt that the presence of the mongoose in large numbers in a district will in this way have an unwelcome effect on the numbers of insects present.
- (iv.) The complete extermination of the mongoose would probably lead to a recrudescence of the damage caused by rats which, in some countries, is a serious item.

VARIATION OF FOOD ACCORDING TO SEASON AND LOCALITY.

In order to see if there is any considerable variation in the food of the mongoose according to conditions, the following table (III) has been prepared showing the number of stomachs containing the various foods separated first according to those taken in the sugar estates which are usually more or less open country, and those taken on cacao estates or in the bush surrounding the towns, both of which are covered with trees; and secondly according to whether killed in the dry or in the wet season.

TABLE III.—SHOWING VARIATION OF MONGOOSE FOOD ACCORDING TO LOCALITY AND SEASON.

		Cacao.	Sugar.	Dry.	Wet.
TOTAL STOMACHS WITH CONTENTS		48	118	85	81
<i>Vertebrates</i>	—Common rat	2	24	18	8
	Spiney rat	1	1	2	0
	Miscellaneous birds	4	10	6	8
	Domestic fowl	9	1	6	4
	Fowl eggs	0	2	1	1
	Lizard	6	11	10	7
	Snake	9	9	4	14
	Frog	1	14	5	10
	Toad	2	12	6	8
	Fish	2	4	5	1
<i>Insects</i>	—Grasshoppers	42	94	73	68
	Mole-crickets	0	2	0	2
	Crickets	2	1	1	2
	Cockroaches	15	35	22	28
	Stick-insect	1	0	1	0
	Moths	0	3	2	1
	Caterpillars	0	2	0	2
	Fly larvæ	4	5	6	3
	Plant bugs	0	2	1	1
	Lamellicorn beetles	11	15	6	20
	Lamellicorn larvæ	0	4	2	2
	Carabid larvæ	12	17	20	9
	Weevils	1	6	1	6
	Miscellaneous beetles	9	24	18	15
	Ants	0	2	1	1
<i>Other</i>					
<i>Arthropods</i>	—Spiders	13	25	14	24
	Scorpion	0	1	1	0
	Centipedes	7	7	1	13
	Millipede	0	1	1	0
	Tick	0	1	1	0
	Crabs	0	3	2	1
<i>Vegetable Matter</i>		10	21	14	17

An inspection brings out the following contrasts which are possibly of significance.

LOCALITY.

- (i.) Twenty-two rats were found in 118 stomachs on the sugar estates as compared with 8 in 49 stomachs in the cacao districts. This may be due to there being a greater number of rats in the sugar districts, but the greater facilities for escape afforded to the rats by the trees in the cacao districts will also affect the result.

- (ii.) The Total number of birds is relatively higher in the cacao districts, but this is entirely due to the greater number of domestic fowls which are much commoner round the numerous small houses of the cacao planter than on the sugar estates.
- (iii.) The number of frogs and toads destroyed is relatively much larger in the sugar districts than in the cacao.
- (iv.) The number of snakes destroyed is relatively higher in the cacao districts.

SEASON.

- (i.) The number of rats destroyed was more than twice as great in the dry season as in the wet.
- (ii.) The number of snakes destroyed was more than three times as great in the wet season as in the dry season.
- (iii.) The number of frogs and toads destroyed was nearly twice as great in the wet season as in the dry.
- (iv.) The number of adult Lamellicorn beetles (including "hardbacks") was more than three times as great in the wet season as in the dry. This is easily explained by the fact that most of these hatch out in the wet season. On the other hand the number of Carabid larvæ was greater in the dry season.
- (v.) The number of spiders destroyed was greater in the wet season.
- (vi.) Of the sixteen centipedes destroyed only one was taken in the dry season, and that one in February after a wet January.

COMPARISON OF THE NORTHERN AND SOUTHERN DISTRICTS.

It is an apparently well authenticated fact that the mongoose although abundant for many years in the northern portion of the island, has only recently become common in the South. Residents of the Naparima district state that five or six years ago it was a rare event to see a mongoose, while to-day they are seen almost daily running across the main roads or on the traces between the cane fields.

This is further confirmed by the number of mongoose destroyed in the different wards of the island during the years that a government reward was offered for them (1902-1913). These figures are as follows (*Proc. Agr. Soc. Trinidad and Tobago* XIII, 131):—

Northern District	...St. Ann's ...	...	8,143
	Tacarigua ...	...	13,925
	Couva and Chaguanas ...	...	8,200
	Arima ...	...	4,752
Southern District	...Naparima ...	...	43
	Oropuche and La Brea ...	...	Nil.
	Cedros ...	...	Nil.

If the mongoose during its residence in the island has had any serious effect on the relative numbers of the animals on which it preys, it might be possible to trace such an effect by a comparison of its food in the districts where it has been established for many years with those districts in to which it has but lately spread.

With this view Table IV has been prepared showing the stomach contents of 36 mongoose killed at Caroni in the northern part of the island in comparison with the contents of 40 stomachs taken on various sugar estates in the Naparima district (Williamsville, Reform, Harmony Hall, Craignish, Wellington and La Fortunée).

TABLE IV.—COMPARISON OF STOMACH CONTENTS OF MONGOOSE TAKEN IN THE NORTHERN AND SOUTHERN SUGAR DISTRICTS.

				North.	South.
TOTAL STOMACHS				36	40
<i>Vertebrates</i>	—Rats			2	12
	Birds			0	9
	Fowl Eggs			0	1
	Lizards			4	2
	Snakes			5	1
	Frogs and Toads			13	8
	Fish			1	0
<i>Insects</i>	—Grasshoppers			29	36
	Mole-cricket			1	0
	Cricket			1	0
	Cockroach			12	11
	Moth			9	8
	Caterpillar			1	1
	Fly Larvæ			0	2
	Plant-bugs			0	2
	Lamellicorn Beetles			9	6
	Carabid Larvæ			0	10
	Weevils			5	1
	Miscellaneous Beetles			8	7
	Ants			0	1
<i>Other Arthropods</i> —	Spiders			17	8
	Scorpion			0	1
	Centipedes			7	1
	Millipede			0	1
	Crab			1	1
<i>Vegetable Matter</i> —				10	8

An inspection shows the following points of interest:—

(i.) The number of rats destroyed is much larger in the southern (newly infested) district than in the northern.

No other explanation of this appears to be possible but that the long presence of the mongoose in the northern districts has reduced the number of rats available for food.

(ii.) The number of birds destroyed is greater in the southern district; in fact no birds were found in the stomachs of mongoose taken at Caroni.

It must be noted in this connection that Caroni Estate in the north is a large flat area very bare of trees and bush. The southern estates are more broken up by other cultivation and have in general a greater number of trees. Allowing for this it is still possible that the figures indicate that the number of birds in the northern district has been reduced by the mongoose.

(iii.) The number of lizards and snakes is slightly greater in the northern district than in the southern.

Although the excess is not great yet it is entirely contradictory to what would be expected if the mongoose is the chief factor in the supposed reduction in the number of lizards in recent years.

(iv.) The number of frogs and toads destroyed is greater in the north than in the south.

As with the last section these figures scarcely support the idea that the mongoose has been the cause of the extermination of these animals in the district where it has been long established. The results must be qualified however by the fact that the flat low-lying nature of the Caroni district gives rise to a greater amount of standing water and suitable breeding places for frogs and toads. In spite of any long continued destruction there still seem to be a sufficient number in the north to form quite a large proportion of the food of the mongoose.

(v.) Ten predaceous beetle grubs were found in the stomachs of the mongoose from the southern district while none were found in those from the north.

Although probably significant it is doubtful if any conclusion of practical importance could be drawn from the figures. Too little is known of the habits of these insects.

(vi.) A much larger number of both spiders and centipedes were found in the stomachs from the northern section.

The general remarks under IV and V apply here also. There appears to be no evidence that the mongoose has created any unusual scarcity of these animals in the districts that it has inhabited for many years.

GENERAL CONCLUSIONS.

Although the results obtained from the comparison of the food in the northern and southern districts are somewhat contradictory it is probable that the conclusions given under Table II (p. 181) are more or less justified and that the presence of the mongoose, except in limited numbers, on an estate in Trinidad is undesirable. Special conditions in other localities (such as poisonous snakes or very severe damage from rats) might cause the balance to be in its favour, but even in these cases it should be possible to find some less risky method of control.

The present method of paying one shilling per head seems to meet the conditions, and as it will automatically cease to act whenever they become too scarce to make their capture a paying business, it is not likely to be carried to the point of extermination.

Although there is good evidence that in the early days of its introduction into Jamaica it greatly reduced the number of rats which were an extremely serious pest, there is no doubt that the mongoose should not be introduced into any country where it does not now exist. Perhaps the most unfortunate introduction up to the present has been into British Guiana, whence it may in time spread through the whole of continental America. It has here ceased to be a local problem, as in the smaller islands, but one that concerns all the neighbouring countries and specially severe methods should be adopted to prevent its spread.

In conclusion I should like to thank the various planters for their willing assistance in obtaining for me the necessary stomachs and Mr. F. W. Urich for his unfailing help with regard to some of the identifications.

Finally I suggest to those in a position to carry it out, that the food of the mongoose be now investigated in India to see if there has been any change in its diet since its introduction into the West Indies. It is hardly too much to say that many thousands of pounds and many years of worry would have been saved to the planters in this part of the world if this had been undertaken, not now, but *before* the mongoose was introduced, almost fifty years ago.

RATS AND MONGOOSE IN THE WEST INDIES.⁽¹⁾

THE mongoose was introduced into the West Indies in the early seventies of the last century, and within a space of about ten years had spread to all the islands where it is now known to occur, namely, Jamaica, Trinidad, Tobago,⁽²⁾ Grenada, St. Vincent, Barbados, St. Lucia, Antigua, and St. Kitts-Nevis. It does not occur in Dominica, Montserrat, (Tobago), Barbuda, the British Virgin Islands nor Carriacou. The mongoose is found in Cuba and Santa Cruz. In 1907 it was reported in a meeting of the Jamaica Agricultural Society that a correspondent in Mexico had asked to have some mongoose sent to him in order that the species might be established in that country. The Secretary of the Society was not able to comply, because of a lack of suitable shipping facilities, but if the individual interested in importing them was persistent it is likely that he has been successful, and that before this time the mongoose has become established in that country.

Rats, which seem to occur wherever man exists, were to be found in these islands from very early times. The black rat and the brown or grey rat, both of Old World origin, have been brought to the West Indies with the shipping. The "cane piece" rat of Jamaica appears to be of uncertain origin. It is said to have been larger than either of the other two, and distinctly marked.

Previous to the introduction of the mongoose the injury to the sugar-cane by rats was so great that rat-catching was a regular part of the routine of many, if not of most, sugar estates. Not only did rats cause much injury to the canes, but they were a source of direct expense. It has been estimated that in Jamaica the losses to the island as a whole amounted to as much as £100,000 per annum, while some estates paid as high as £300 to £400 per year for rat-catching. The rat catchers were a source of further expense, for they often pulled down walls in order to catch the rats, and these walls had afterwards to be repaired.

The introduction of the mongoose into Jamaica was found to be of great value to the island, a saving of some £45,000 per annum being estimated as the direct and almost immediate effect of the reduction in the number of rats due to the activities of the mongoose, and, in all the islands where the mongoose was introduced for the purpose of killing rats, the value of the introduction was appreciated at once, rats were much reduced in numbers, and the losses in sugar-canes and the expenses of rat-catching were saved to a large extent.

After a time, some ten to fifteen years, complaints began to be made that the mongoose had failed to kill off all the rats but had taken heavy toll of many ground-nesting birds, lizards, and toads, and had caused much loss of poultry and eggs. Later, the apparent increase of insect pests of crops was charged to the account of the mongoose, which having upset the balance of nature by killing off many insect-eating forms, had thus provided for the increase of undesirable insects.

(1.) Reprinted from the *Agricultural News*, XVII, 1918, 337-9. See also note on p. 166.

(2.) This is an error which has since been drawn attention to in the *Agricultural News* as the result of a letter from Mr. H. P. C. Strange, Commissioner-Warden of Tobago. The mongoose is not known in Tobago. (W.G.F.)

In Jamaica, this phase passed in a short time, and for the past fifteen years or more the opinion seems to have prevailed in that colony that the mongoose is of sufficient benefit more than to offset its depredations.

In Trinidad, Barbados, Antigua, and St. Vincent, on the other hand, the mongoose has been, and still is considered an unmitigated pest by a very large proportion of the people.

It should be stated, however, that in 1911 a Commission appointed by the Governor of Barbados to enquire into the usefulness or otherwise of the mongoose as a rat killer, came to the conclusion that the mongoose was of value in keeping the rats in check, and that the mongoose destruction law ought to be repealed. This was not done, and the law is still in force. It may be remarked, however, that the Select Committee, which in 1917 reported in favour of mongoose destruction, found that the impression prevailed that the law of 1909 was not operative, and in consequence practically no money was being claimed as bounty for mongoose heads.

In the islands where the mongoose does not occur, there are laws against its importation. Such Ordinances occur in Montserrat, Barbuda, the British Virgin Islands, Dominica, and Carriacou.

The mongoose was introduced into St. Lucia for the direct purpose of combating the serpent, the Fer-de-lance, and it has been so successful as a snake killer that up to the present no serious complaints have been heard of its being a nuisance in that island. The mongoose in St. Lucia lives principally in the lower, more open lands in the neighbourhood of dwellings and cultivations, and preys upon poultry to some extent. The result is that very few serpents appear in these, the inhabited districts.

The Select Committee (1917) of the House of Assembly, Barbados, was of opinion that the destruction of the mongoose ought to be continued: but did not refer to the destruction of rats.

Rats are not only pests of sugar-cane, but of every crop, and all stored food products and many household articles suffer from their depredations. They destroy books and papers, gnaw through the wood-work of buildings, and often dig out the interior of walls, and undermine cement floors and masonry foundations. They are the cause of epidemics of disease, especially plague, which being a rat-borne disease, is communicated to human beings by the bite of the rat flea.

At the present time the situation with regard to rats and mongoose appears to be as follows. In Jamaica it is realized that rats are still a serious pest, and that any reduction of the numbers of their enemies would immediately be followed by an increase in the numbers of rats, and in the damage done by them. Consequently, the feeling in that colony appears to be that the mongoose is doing more good than harm. Vigorous efforts are being made to reduce the numbers of the rats, although there seems to be no government action in the matter.

In Trinidad the mongoose is looked upon as being all harm and no good, at least, that the harm done by it is so much in excess of the good that the latter is hardly taken into account at all. In St. Vincent and Antigua the same opinion seems to prevail.

In Barbados the feeling at the present time on the part of that portion of the community represented by the Select Committee of the House of Assembly appears to be that the mongoose should be destroyed, without regard to any useful purpose it may have served or may be expected to serve. In 1911, however, the Commission on mongoose reported that on account of its value as a rat killer the mongoose ought not to be destroyed. Probably the real attitude toward the mongoose and rat question in Barbados is somewhere between that of the Commission of 1911 and the Select Committee of 1917. At times the rats are very destructive—then the mongoose ought to be encouraged at other times the depredations of the mongoose are noticed, and attacks of insect pests experienced, and then the feeling is that the mongoose should be exterminated.

The situation in Grenada is shown by letters from the Colonial Secretary and the Agricultural Superintendent, to the effect that the mongoose was not a pest in that Colony, and that there were no laws or Ordinances dealing with its control. These letters were in reply to a letter addressed in 1917 by the Trinidad Government to the Government of Grenada and to the Governments of other West Indian Colonies as to the status of the mongoose, and the steps being taken to control it.

The introduction of the mongoose into these islands has very seriously upset the balance of nature, and it is likely that the introduction of the rat did the same. These two animals now form such a part of the faunistic economy that the complete extermination of either one would be likely to cause as great an upset in the balance of nature as their introduction has done. Exterminate all the rats, and the mongoose would be likely to reflect the new condition by increased ravages on other sources of food. Exterminate the mongoose, and the rats would without doubt soon become as serious pests as ever they were in the past.

It appears to be quite certain that the mongoose has influenced the abundance of ground-nesting birds, and of insectivorous animals such as toads and lizards, and that rats have taken to nesting in trees in order to escape from them. Perhaps the rat, now that it climbs to escape the mongoose, is more destructive than formerly to the eggs and nestlings of many of our tree-nesting birds.

In all these ways the mongoose may be said to be responsible for the decrease in the natural enemies of the insect pests attacking our crops; but it must be remembered that there were serious insect pest epidemics in the West Indies before the introduction of the mongoose.

The problem of rat and mongoose control involves the question whether this shall be in any way the duty of Government, or shall be left to private energy and enterprise. The course taken by the several Governments, consisting in paying a bounty for rat carcasses, was not eminently successful in the control of rats. After long years of such effort the mongoose was introduced to aid in the matter.

The evidence appears to show that both the rat and the mongoose can be controlled on any given property and in any given district by

individual effort. If this is so, concerted action of individuals over large areas, or throughout an entire colony, would reduce this undesirable animal to small numbers.

It would appear, then, that the first step in such control would be individual action, concerted and unified through the Agricultural Societies or similar bodies. When the efforts of individuals are carried as far as they can be, the Government may be asked to help in matters of advice and assistance in regard to poisons, traps, and methods to be employed to extend and increase the effect of the work of the individual.

MONGOOSE ORDINANCE 1918.

TRINIDAD AND TOBAGO.

No. 8.—1918.

I ASSENT,

[L.S.]

J. R. CHANCELLOR,
Governor.

27th April, 1918.

AN ORDINANCE relating to the importation and destruction of the Mongoose (*Herpestes Mungo*).

Be it enacted by the Governor of Trinidad and Tobago with the advice and consent of the Legislative Council thereof as follows:—

1. This Ordinance may be cited as the Mongoose Ordinance, 1918.

2.—(1.) No person shall import or cause to be imported into this Colony any live animal of the description known as Mongoose.

(2.) Any person contravening the provisions of this section is liable on summary conviction before a Magistrate to a fine not exceeding £20, and in default of payment to imprisonment, with or without hard labour, for any term not exceeding three months.

3. Any officer of Customs finding a live Mongoose among any goods or baggage entering the Colony shall forthwith seize the same and destroy or cause the same to be destroyed.

4.—(1.) No person shall keep or have in his possession any live Mongoose.

(2.) Any person contravening the provisions of this section is liable on summary conviction before a Magistrate to a fine not exceeding £20, and in default of payment to imprisonment, with or without hard labour, for any term not exceeding three months.

(3.) The convicting Magistrate shall order any Mongoose in respect of which an offence under this section has been committed to be destroyed.

5.—(1.) Any Magistrate or Justice who is satisfied by proof on oath that there is reasonable cause for believing that there is in any house, building, premises or other place any Mongoose, may issue a warrant under his hand authorizing some member of the Constabulary Force named therein to enter and search such house, building, premises or other place for such Mongoose.

(2.) Every such warrant may be issued and executed on a Sunday.

6.—(1.) It shall be lawful for :—

(a.) The Director or Assistant Director of Agriculture or

(b.) The Chief Inspector or an Inspector appointed under the Plant Protection Ordinances; or

(c.) Any person authorised in writing by the Director of Agriculture; to enter with such assistants as may be necessary upon any land and search for, capture and destroy Mongoose.

(2.) The occupier, or if there is no occupier, the owner of any such land shall pay to the Director of Agriculture the sum of one shilling for every Mongoose destroyed under the provisions of this section.

(3.) If a Mongoose is destroyed by or under the direction of any person named in Sub-section (1) (a) and (b) of this section, any amount received in respect of such destruction shall be paid into the Treasury, otherwise such amount shall be paid by the Director of Agriculture, when received, to the person by whom or under whose direction any Mongoose is destroyed.

7.—(1.) The Director of Agriculture may issue an order in writing in the form in the Schedule to this Ordinance to the occupier, or if there be no occupier to the owner, of any land, directing him to take within a definite time from the service upon him of such order to be specified therein all such measures as may be necessary for the destruction of Mongoose on his land.

(2.) If there is no occupier on any land, service of any order under this Ordinance may be made by affixing the same in some conspicuous part of the land

8. If any owner or occupier shall fail to comply with the directions contained in any order, any Inspector authorised either generally or in a special case by the Director of Agriculture may, with or without assistants, enter upon such lands and take such steps as may be necessary for properly and effectively carrying such order into execution.

9. All payments directed to be made to the Director of Agriculture under Section 6 of this Ordinance and all expenses incurred by or under the direction of the Director of Agriculture in carrying into effect any order made under Section 7 of this Ordinance shall be a first charge on the land affected by the order, and payment thereof may be enforced forthwith in the manner provided by the Land Charges and Land Taxes Ordinance (No. 204).

10.—(1.) No person authorised under the provisions of this Ordinance shall be deemed a trespasser by reason of any entry or destruction or action taken or thing done under this Ordinance, or be liable for any

damages occasioned by carrying out any of the provisions of this Ordinance, unless the same were occasioned maliciously and without reasonable and probable cause.

(2.) Proceedings taken under this Ordinance shall not be rendered void by reason of any informality in any order or notice made or given.

11. The Ordinances No. 123 and No. 27 of 1908 are hereby repealed.

Passed in Council this Nineteenth day of April, in the year of Our Lord one thousand nine hundred and eighteen.

J. M. FARFAN,
Acting Clerk of the Council.

SCHEDULE.

THE MONGOOSE ORDINANCE, 1918.

Order under Section 7.

To _____, occupier (or owner)
of _____ situate at _____
in the Ward of _____
in pursuance of the powers vested in me by the Mongoose Ordinance,
1918, I hereby direct you, within _____ days of the service upon you
of this Order to take all such measures as may be necessary for the
destruction of Mongoose on the following land, namely, (*here describe
the land*).

Dated this _____ day of _____ 19 ____.

A. B.,
Director of Agriculture.

CASSAVA.

CASSAVA EXPERIMENTS 1916-18.

By JOSEPH DE VERTEUIL, F.I.C., F.C.S.

Superintendent of Field Experiments.

EXPERIMENTS on the cultivation of cassava were started in 1914 at the St. Augustine Experiment Station, with the object of ascertaining (a) the best local varieties, (b) the most suitable planting distance, (c) the best part of the sticks to select for planting and (d) the best method of planting *i.e.* on the flat, on banks or in forked holes. The results for the period 1915-16 (1) have already been published so that this report deals with results obtained during 1917 and 1918. In addition to the above, two other items were included in the 1916-18 experiment with the object of ascertaining (a) the best planting season and (b) the best age and time for reaping cassava.

It might be mentioned that in 1914 and 1915 attempts were also made for testing the suitability of planting cassava, with other crops such as corn, cotton, pigeon peas and canes. In every case the result was a failure. Not only the yield of the cassava was poor but the other crops either died back or gave very poor returns.

All the experiments carried out in 1916 and 1917 were made on duplicate plots of approximately $\frac{1}{4}$ of an acre each and the results given are the averages of the plots for the two years.

LOCAL VARIETIES.

When the experiments were started in 1914 difficulty was experienced in obtaining reliable information from planters, large or small, with respect to good yielding varieties. In Trinidad, cassava is not grown as a separate crop but usually as a catch crop in young cacao plantations, as a temporary shade, or in gardens of mixed cultivation. Very little information was obtained with regard to the yield per acre, the only information vouchsafed being that it was a good bearing variety—comparatively of course—as of the several varieties tried only one gave over 5 tons of roots per acre.

Out of fifteen varieties planted in 1916 and 1917 eight have given an average yield of over 5 tons of roots per acre. These were planted at a distance of 8 feet by 8 feet about May and reaped in September of the following year being approximately sixteen months old. The results obtained are as follows:—

TABLE I.—YIELD OF VARIETIES PLANTED 8 FEET APART.

Variety.	Tons per acre.	Variety.	Tons per acre.
Sellier	8.59	Parasol	6.32
No. 12	7.41	Mata Hotel	6.16
No. 13	7.14	No. 14	5.63
Turkey Claw	6.48	Maman l'enfant	5.53

Another variety No. 15 gave 4.98 tons of roots per acre.

Variety "Sellier" is undoubtedly the best local variety so far obtained. Individual plots of this variety having on three occasions given over 10 tons of roots per acre.

These results have been obtained without the aid of manures and having so far been able to detect the best yielding varieties under natural conditions it is probable that better results will be obtained when artificial manures are available, at a reasonable price.

PLANTING DISTANCES.

Four varieties were planted at distances of 4 feet by 4 feet, 3 feet by 3 feet and $2\frac{1}{2}$ feet by $2\frac{1}{2}$ feet respectively. "Sellier" gave 9.05 tons of roots per acre for the 4 by 4 feet, 7.65 tons for 3 by 3 feet and 6.02 tons for the plot planted $2\frac{1}{2}$ feet by $2\frac{1}{2}$ feet. The yield for "Parasol" was 5.80, 7.84 and 6.82 tons per acre, whereas "Turkey Claw" gave yields of 5.51, 7.21 and 5.85 tons and "Maman l'enfant" 6.12, 6.24 and 6 tons of roots per acre when planted at distances of 4 by 4, 3 by 3 and $2\frac{1}{2}$ by $2\frac{1}{2}$ feet respectively. With the exception of variety "Sellier" the highest yield was obtained from the 3 by 3 feet planting; in two instances the $2\frac{1}{2}$ by $2\frac{1}{2}$ feet plots gave better returns than the 4 by 4 feet plots and *vice versa*. Taken together these four varieties gave an average yield of 7.11, 6.49 and 6.17 tons of roots per acre for the 3 by 3, 4 by 4 and $2\frac{1}{2}$ by $2\frac{1}{2}$ feet plantings respectively. Generally, therefore, the highest yield has been obtained from the plots planted 3 feet apart, but it has been observed that both Sellier and Maman l'enfant often give better results when planted 4 feet apart.

SELECTION OF PLANTS.

Sticks were taken as is usually done for obtaining plants. One or two plants were cut off from either end according to the length of the sticks—these would be the "top" and "bottom" plants respectively—the remaining portion being called the "middle" or "centre" plants.

Two varieties were selected for the experiment and the sticks planted at distances of 3 feet by 3 feet. In both cases the "tops" gave the lowest yield which confirms results previously obtained namely that the younger or less mature portion of the sticks are less suitable for planting purposes than the old portions. Similarly the "bottom" plants gave a slightly lower yield than the "centre" plants but the difference is not so marked. Nevertheless, the results clearly show that in order to obtain the best yield from a given variety care should be exercised in selecting the sticks for planting by rejecting the young and very old parts.

PLANTING METHODS.

Experiments for comparing the relative merits of planting (a) on the flat (b) on banks and (c) in forked holes 2 feet square were carried out with the following results:—

TABLE II.—YIELD FROM DIFFERENT METHODS OF PLANTING.

Variety.	Distance planted.	YIELD PER ACRE.		
		On flat.	On banks.	In holes.
		tons.	tons.	tons.
Sellier ...	5 ft. x 3 ft.	8.77	7.49	6.57
Turkey Claw ...	" "	5.78	6.50	6.20
Maman l'enfant ..	" "	6.09	5.76	5.93
Parasol ..	" "	5.96	5.34	6.28

These results show that two of the varieties gave a larger yield when planted on the flat, whereas one variety gave its highest yield on banks and the fourth in holes. Taken together the average yield of these four varieties was 6.64, 6.27 and 6.24 tons of roots per acre for the plantings on the flat, banks and holes respectively. It may be pointed out that the soil at St. Augustine is of a naturally loose and friable nature and that possibly on heavier soils higher returns may be obtained from banks and holes than from plantings on the flat. Nevertheless, should this be obtained it is not probable that the increase yield would justify the extra cost of banking and holing and therefore planting on the flat is generally recommended.

PLANTING PERIODS.

From 1916, experiments have been carried out with the object of ascertaining the best time for planting cassava. Accordingly from the end of April and thence monthly to March of the following year, duplicate plots were planted of the same variety. These plots were reaped and the percentage of starch determined between September and October when the plants were from 6 to 17 months of age according to the date planted.

The results obtained for the 1917-18 experiments are given below. They are similar and in every respect confirm those obtained the previous year.

TABLE III.—VARIETY "SELLIER" MONTHLY PLANTING.

Date planted.	Date reaped and tested.	Approximate age when reaped.	Yield of tubers per acre.	Starch in tubers.	Yield of starch per acre.
		Months.	Tons.	Per cent.	Lb.
21st April, 1917	16th Sept., 1918	17	10.77	15.26	3,476
21st May, "	18th " "	16	9.82	14.96	3,291
21st June, "	20th " "	15	6.40	15.66	2,266
20th July, "	23rd " "	14	6.35	14.33	2,038
21st Aug., "	25th " "	13	4.97	16.63	1,851
21st Sept., "	27th " "	12	4.46	16.02	1,600
20th Octr., "	30th " "	11	4.03	17.91	1,617
21st Novr., "	2nd Octr., "	10	4.03	17.01	1,535
20th Decr., "	4th " "	9	2.73	15.14	926
21st Jany., 1918	7th " "	8	3.30	14.99	1,108
20th Feby., "	9th " "	7	1.59	12.53	446
21st Mar., "	11th " "	6	1.42	12.35	393

REAPING PERIOD.

In this experiment twelve duplicate plots were planted about the middle of April. Two plots were reaped in the middle of October and thence monthly to September of the following year so that the cassava was from 6 to 17 months old. The percentage of starch was also estimated in samples from these plots about 24 hours after they were reaped.

The following are results obtained for the 1917-18 experiments. They also are similar and confirm the results of the previous year.

TABLE IV.—VARIETY "SELLER"—MONTHLY REAPINGS.

Date planted.	Date reaped and tested.	Age when reaped.	Yield of tubers per acre.	Starch in tubers.	Yield of starch per acre.
		Months.	Tons.	Per cent.	Lb.
9th April, 1917	10th Oct., 1917	6	2.02	7.86	356
11th „ „	12th Nov., „	7	3.70	15.28	1,266
12th „ „	12th Dec., „	8	5.04	22.03	2,487
12th „ „	10th Jan., 1918	9	5.64	22.47	2,839
12th „ „	12th Feb., „	10	5.95	24.15	3,219
13th „ „	20th March, „	11	6.40	27.62	3,060
13th „ „	10th April, „	12	6.22	27.51	3,833
13th „ „	13th May, „	13	6.79	24.25	3,688
12th „ „	12th June, „	14	8.65	24.30	4,708
12th „ „	11th July, „	15	8.57	19.40	3,724
13th „ „	12th Aug., „	16	8.54	18.32	3,504
11th „ „	11th Sep., „	17	8.88	22.22	4,420

The results recorded in this and the preceding table shew that (1) the yield of the roots has increased generally from month to month with the age of the plants (2) the percentage of starch does not necessarily increase with the age of the plants but that it is subject to great fluctuations according to the weather experienced at time of reaping.

From all the plots reaped in July, August and September, Table IV, it was observed that a large proportion of the tubers had rotted and this may account for the fact that no increase in yield was obtained from these plots as compared with the plot reaped in June. From this it is evident that cassava should be reaped before July and it should then be

not less than 16 to 17 months old as a better yield may be expected at that age than at 14 to 15 months of age *vide* Table III.

An important consideration in the growing of cassava is not only to obtain the largest tonnage of roots per acre but also the highest percentage of starch in the roots at the time of reaping. So far as have been ascertained there is little or no difference in the percentage of starch from the different varieties.

The age of the plants also appears to exert very little influence on the percentage of starch in the roots at least for cassava over eight months of age. For example cassava 10 and 11 months old reaped in the dry season contained a larger percentage of starch than cassava 15, 16 and 17 months of age reaped during the wet season *vide* Table IV. All the determinations made, over a period of two years, show that cassava reaped between July and December seldom contains more than 22 per cent. of starch, but that the amount usually found varies from 15 to 18 per cent. Reaped between January and June cassava of the same age seldom contains less than 22 per cent. of starch and often reaches over 27 per cent. in March to April. The dry season therefore is undoubtedly the proper season for reaping the cassava and as it has been found that the yield increases up to 17 months of age it is probable that the best planting season would be from September to November so that the roots may be reaped between February and April at 17 and 18 months of age.

The experiments so far made do not show whether an increased yield may be expected from cassava over 18 months of age. Accordingly experiments for determining whether it is more profitable to plant cassava about May and reap from January to April at 20 to 24 months of age or planting about September and reap from January to April at 16 to 19 months of age have been started this year, but the results will not be available before 1920.

MANURIAL EXPERIMENTS.

Preliminary small scale experiments made on plots of approximately 1-400 of an acre show that a yield of from 10 to 13 tons of roots per acre may be obtained from an application of 20 tons pen manure or 300 lb. artificial manures per acre. The pen manure plot gave a yield of 18.45 tons and the two artificial manure plots 10.82 and 11.60 tons of roots per acre. The artificial manure applied consisted of a mixture of 30 lb. sulphate of ammonia, 180 lb. dissolved bones, 45 lb. fine bone meal and 45 lb. sulphate of potash. An extra amount of sulphate of potash, at the rate of 100 lb. per acre. was applied to the plot which gave 11.60 tons of roots per acre. These experiments were made with variety "Sellier" and the control plots only gave 4.85 tons per acre. The yield from the control plots is low for this variety and is accounted for by the fact that they were overshadowed by the fast growth of the manured plots. The average yield for variety "Sellier" for the past two years has been from 7 to 8 tons of roots per acre.

SEEDLING CASSAVA.

Owing to the difficulty of obtaining high yielding varieties and the low yield obtained from most of the local varieties, attempts have been made at growing new varieties from seed. Cassava does not seed very profusely and some difficulty has been experienced in collecting good seed as only a small proportion of the seed appear to come to maturity.

Out of 30 seedlings raised in 1916, six have given sufficiently promising yields to be propagated by cuttings. The yield obtained from the single plants at approximately 19 months of age has been as follows:—

No. 8 ...	... 7½ lb.	No. 17 ...	... 5 lb.
No. 6 ...	...25 „	No. 24 ...	... 5 „
No. 16 ...	...12 „	No. 30 ...	... 4½ „

This represents a calculated yield of from 10·26 to 54·00 tons of roots per acre planted 3 feet by 3 feet and 5·77 to 30·88 tons if planted 4 feet apart.



STOCK.

STRONGYLUS OF CATTLE, SHEEP, GOATS, ETC.

Stomach Worms and Lung Worms.

Cattle, Sheep, and Goats, as well as various other animals, are liable to the attacks of certain parasitic worms or Nematodes, one group of which belong to the Zoological family the *Strongylidae*.

Special attention has been given to these important animal parasites by Dr. B. H. Ransom, Chief of the Zoological Division, Bureau of Animal Industry, of the United States Department of Agriculture, who has very courteously furnished information which will be of value in dealing with the attacks of *Strongylus* in this Colony, using this name well known here as indicating the various stomach and lung worms which affect certain of our domestic animals.

One of the commonest of the stomach worms, and probably one of the chief here is *Hæmonchus contortus* (or *Strongylus contortus*) which Dr. Ransom records as having been found in cattle, sheep, goats, moose, antelopes, chamois, bison, deer, caribou, the Mexican mountain sheep, other wild sheep and even man. The world-wide distribution of this parasitic worm is shown by Dr. Ransom recording it as having been collected in Europe, United States, Asia, Africa, Australia, South America and New Zealand.

No study by a specialist has yet been made of these parasitic worms in Trinidad and Tobago, but there is little doubt that this world-wide species is present. The following notes by Dr. Ransom on the life history and treatment of stomach and other parasitic worms are therefore of general interest and value.

They are followed by notes by Messrs. J. McInroy and H. Meaden in which they summarize their knowledge of the history of *Strongylus* in the Colony, and the practical measures they have found of service in their experience at the Government Farm in Trinidad and Tobago respectively. W.G.F.

Notes on Stomach Worms, etc.

By DR. B. H. RANSOM.

Chief Zoological Division, Bureau Animal Industry, United States
Department of Agriculture.

I.—STOMACH WORMS.

During the summer season lambs are liable to suffer severely and frequently die from infestation with parasitic roundworms, commonly known as stomach worms. Loss of flesh, weakness, digestive disturbance, diarrhea or constipation, capricious appetite, and paleness of the skin and mucous membranes of the eyes and mouth are common symptoms. Watery swellings under the jaw are often observed. If an

affected animal is killed and the fourth stomach opened and carefully examined, it will be found to contain numerous small worms, $\frac{1}{2}$ to $1\frac{1}{2}$ inches long and about as thick as an ordinary pin.

LIFE HISTORY.

The life history of the stomach worm is essentially simple. The eggs, which are of microscopic size, are passed in the droppings of infested animals. Most adult sheep harbour at least a few stomach worms, and it is from this source that the lambs become infected through the medium of the pasture. The eggs in the droppings hatch out in a few hours in warm weather. The unhatched eggs or newly hatched worms are not infectious, but in a week or less in warm weather, to three or four weeks in cool weather, the young worms develop to the infectious stage and crawl up blades of grass ready to be swallowed by a suitable host, a sheep or other ruminant. They crawl up from the ground only in rainy weather, when dew is on the grass, or when atmospheric conditions are such that the grass blades are covered with a film of moisture. When the worms become dry they cease their activity, but remain on the grass in an inactive condition until the air again becomes overcharged with moisture when they resume their upward migrations. Whether active or inactive they are ready to continue their development when swallowed by a suitable host.

The eggs and newly hatched worms succumb quickly to freezing or drying, but after the worms have reached the infectious stage they are able to survive repeated freezing and long periods of dryness. They have been kept alive in a dried condition for 85 days, and for six months in moist earth. Infection has been found to persist in a field vacated for over seven months; that is, from October to June. It appears quite probable that young worms may develop to the infectious stage on the skin of infested sheep in adherent faecal material, so that there is an evident possibility that lambs sometimes become infected from the skin of their mothers while suckling. So far as known, infection by penetration of the young worms through the skin, which occurs in the case of hookworms, does not occur in the case of the stomach worm; but sufficient investigation has not yet been made to exclude this possibility.

When swallowed by a sheep or other ruminant the young stomach worms develop to maturity in two to three weeks, and begin producing eggs. The eggs do not hatch in the body, so that no increase in the number of parasites occurs except as more young worms are taken in from time to time. The adult worms may live for many months in the stomach of their host. In experiments in which sheep were kept on board floors and handled in such a manner that the chances of fresh infection were reduced to a minimum, stomach worms were still present after a year and a half; most of the worms, however, had disappeared.

PREVENTION.

It is apparent from the foregoing that the problem of protecting lambs from infestation with stomach worms is a difficult one. As yet no satisfactory solution has been discovered. In view of the rapidity of

development of the young worms and their great vitality, the changing of pastures sufficiently often to avoid infection is generally out of the question under practical conditions; but if the sheep are changed to fresh pasture frequently, and if overstocking and close grazing are avoided, the degree of infestation can be reduced to a minimum. Infested pastures and fields which have been plowed and reseeded are comparatively safe when ready again for grazing, but on the other hand, permanent pastures grazed closely and stocked to their limit, year after year are particularly dangerous. Moving from field to field at frequently intervals, even though it is not always possible to use fields which have been under cultivation since the last grazing, helps to keep down the number of parasites. Wet pastures should be avoided. Early lambs are less likely to suffer from stomach worms than late lambs, and, furthermore, in northern localities they can be marketed before the season of serious stomach-worm troubles arrives.

II.—THE USE OF BLUESTONE OR COPPER SULPHATE IN THE TREATMENT OF STOMACH WORMS.

In the preparation of the dose use only clear blue crystals of copper sulphate (bluestone). Crush the crystals to a fine powder when ready to make up the solution. Dissolve $\frac{1}{2}$ pound (avoirdupois) of the powdered crystals in one pint of boiling water, using a porcelain or enamel-ware dish as the bluestone will corrode most metals. Then add enough cold water to make the solution up to 3 gallons, using wooden, earthenware, or other non-metallic receptacles. This will make an approximate one per cent. solution and will be enough to dose 100 adult sheep allowing for about a ten per cent. waste.

The amounts of the dosage for both old sheep and lambs are :—

For lambs under one year of age ...	...1 $\frac{1}{2}$ ounces (50cc) ;
For sheep past one year old ...	...3 $\frac{1}{2}$ ounces (100cc.)

A glass with marks scratched on the side with a file may be used for measuring the doses.

The drenching apparatus consists of a small strong rubber tube, about three feet long and $\frac{3}{8}$ inches in diameter, a hard rubber, porcelain or enamel-ware funnel, which is fastened to one end of the tube and a brass mouthpiece $\frac{1}{4}$ inch in diameter and 9 inches long fastened to the other end of the tube.

Customarily the treatment is given after the sheep have been starved over night, but apparently may be given with equal good results without preliminary fasting, providing the animals are not gorged with feed or water when treated.

While being drenched the sheep should remain on all four legs with its head held horizontally. This is important for if the head is held above the horizontal, (noze higher than the eyes) there is danger of some of the fluid passing into the lungs thereby causing pneumonia and almost certain death. Measure the amount of the dose in the measuring glass and then after the drenching tube is in position, pour the dose slowly

into the funnel. The metal mouthpiece of the drenching tube should be placed between the jaws in the space between the teeth at the side of the mouth and directed backward, but should not reach farther than the base of the tongue. In order to prevent the sheep from stopping up the end of the mouthpiece with its tongue and thus interfering with the flow of the liquid, the person holding the mouthpiece in the sheep's mouth should give it a rotary motion. This will tend to keep the sheep swallowing, prevent plugging of the tube and also tend to obviate the danger of the fluid's entering the lungs. The fluid should not be administered more rapidly than the sheep can comfortably swallow.

Care in the administration of the dose is highly important as carelessness or any undue haste is liable to have serious results. The copper sulphate treatment, like the administration of medicines in general, is safest in the hands of a competent veterinarian.

III.—LUNGWORMS IN CATTLE.

Treatment for lungworms in cattle is often very unsatisfactory. Certain medicines may be injected into the windpipe, but the danger of producing suffocation or traumatic pneumonia is so great that the treatment is apt to be unsatisfactory unless the administrator is experienced or very skilful. If such treatment is attempted it is advisable to employ a veterinarian. Frequently it is even more advisable to market stock, provided they are in marketable condition. For more valuable animals the intratracheal injections of the following may be tried :

Oil of turpentine	...	...	2 drams.
Phenol	...	...	20 minims.
Chloroform	...	...	$\frac{1}{2}$ dram.

The above to be mixed and injected at a single dose.

Another and probably better method, but one which also necessitates the employment of a veterinarian, calls for inserting a special tube in the windpipe and leaving it there for three days. Each day a mixture of one part creosote, 50 parts alcohol, and 50 parts distilled water is administered through the tube in the form of a spray produced by an atomizer which is part of the apparatus.

The life history of the lungworm so far as it is known, is as follows : The adult worms live in the bronchi and give rise to numerous embryo worms which are coughed up on to the pasture or swallowed and passed out in the faeces. After some development, the young worms are apparently swallowed in contaminated food and water and make their way to the lungs. Cattle are therefore infested from food and water, but not from contact with one another. Preventive measures are therefore a matter of clean water supply and of clean pasture. Infested animals should be isolated and either treated or disposed of. Pastures should be drained and kept free from standing water. Wet pastures furnish the most favourable conditions for the development of these and other worms. Fresh clean pasture, pasture rotation or at least rotation

of different kinds of stock on the permanent pastures, are all measures that will aid in keeping down worm infestation.

Plenty of nourishing food and a liberal supply of salt are important aids in enabling live stock to withstand the attacks of lungworms and other parasites. Losses may sometimes be stopped or minimized by removing stock from pasture and placing them in dry well drained yards or stables, maintained in a clean and sanitary condition. Investigators at the University of California claim good results from the following method of treatment for lungworms:

Chloroform injected into the nostrils will stupefy large numbers of lungworms and cause paroxysms of coughing which will eliminate some of them. The amount of chloroform to be given varies, but enough should be given to render the animals slightly groggy. Three c.c. is the maximum dose for sheep and goats, 5 c.c. for hogs, and 11 c.c. for calves. There are about 4 c.c. in a teaspoonful. A dose of Epsom or Glauber salts should be given two hours after administration of the chloroform. The treatment should be repeated every 3 to 5 days until the animals respond. As many as three treatments may be necessary. A fountain-pen filler may be used to inject the chloroform into the nostrils. Tipping the animal's head back facilitates the operation. The nostrils should be closed for a few moments with the hand after the chloroform is injected.

IV.—NODULAR DISEASE OF CATTLE.

In its adult stage *Oesophagostomum radiatum* occurs in the lumen of the large intestine. The larvæ are found in the wall of the large and small intestine, chiefly the latter. The life history which has been worked out by Marotel (1908) is direct without intermediate host. The eggs passed in the feces, hatch, and the larvæ after arriving at a certain stage of development are ready to be taken into the body of the host animal. When they reach the intestine they become encysted in the wall of the intestine, undergo further development, and finally pass into the lumen of the intestine and become mature.

No satisfactory treatment is known. Preventive measures consist in avoiding wet, low-lying pastures, changing animals to fresh ground as often as possible, supplying them with clean water, plenty of nourishing food, and a liberal allowance of salt. Animals known to be affected should be isolated from the rest of the herd. The nodular worm of cattle does not affect sheep, horses, or any other of the domesticated animals except cattle.

Notes on Strongylus in Trinidad.

By J. McINROY.

Manager, Government Farm, Trinidad.

The Strongylus Parasites are known in every country where Stock are kept. In England the disease is known as Husk or Hoose, or Vermineous Bronchitis, and sometimes as Bronchial Pneumonia; in the United States it is known as Filaria Bronchitis.

The Veterinary correspondent of the "*Farmer and Stock-breeder*" Mr. Harold Lenny, M.R.C.V.S., in his book "*Home Doctoring of Animals*" states "the importance of the part played by parasites is even yet not realised. Some of the most talented and industrious men in the medical and veterinary professions have given their lives to the study of parasitism and published for our guidance the valuable results obtained, and still the farmer and stock-breeder suffer seriously from largely preventable parasitism." This is not surprising considering that the life history of these parasites is yet not fully known, and when we again consider that although the human parasite Hookworm, was first discovered in 1838 it was not until 1899 that it was recognised to be the cause of anæmic disease.

As already stated Strongylus is known in every country where stock are kept. In cold climates the disease is most prevalent during the Autumn in low-lying badly drained pastures, but the fact that the lands are low-lying or badly drained, is not the source of infection. The parasite must first be carried there by animals, or from already infected higher lands, by the action of rain or snow; the parasites in their embryo stage simply find a suitable resting place on low lands before coming into life, the water and dampness being necessary to their existence.

In the tropics where we have no frost to keep these parasites in check, the disease becomes rampant especially in a hot moist climate like Trinidad. At the Government Farm St. Joseph where the lands are flat and low-lying, Strongylus has usually made its ravages more felt after a heavy wash from the hills, when the St. Joseph River overflowed its banks. In Trinidad the worst months are October, November and December. My attention has been drawn to some estates that usually suffer most in the dry season; in every case where that happened, the pastures were not low-lying but very often on hilly lands with an artificial pond at the lowest part which received all the drainage from the higher lands. In these cases the source of infection was first, infected animals in the pasture, and afterwards, the pond became a general source of infection especially in the dry season.

FIRST RECORD IN TRINIDAD.

There is no doubt that Strongylus has existed in Trinidad for many years although not known by that name. In the Farm records no mention is made of it until 1897 when Mr. Pogson, then Government

Veterinary Surgeon diagnosed the death of a bull at St. Clair as due to *Strongylus*. In the same year six calves died from Peritonitis, consequent on worms, eating dirt, etc., and the following year eight calves died from scour, dysentery, *Strongylus*, etc. In 1902 the Government Veterinary Surgeon diagnosed the death of 28 sheep at Tobago to be from *Strongylus*. Mr. C. W. Meaden then Manager of the Trinidad Government Farm was of the opinion that these sheep were infected before export from Halifax, and that the disease only required the conditions here to develop into an epidemic. Although first recognised at the Government Farm it is evident that it prevails all over Trinidad and Tabago.

The *Strongyli* group of parasites are a numerous family, some inhabit the digestive tract and some the air passages.

SYMPTOMS.

In Trinidad the species that does the most harm amongst young cattle is a *Strongylus* causing Parasitic Bronchitis or Husk. This is often mistaken for simply a cold, and when the lungs get congested from the quantity of worms with which they are infested, the disease is then mistaken for pneumonia instead of being recognized as parasitic pneumonia. When in this condition the slightest cold proves fatal. Animals in the advanced or anæmic stage suffer from scour and diarrhoea, which many people do not attribute to *Strongylus*, meanwhile, the animal gets more and more emaciated until it dies. In the stomach form of the disease the animal sometimes dies from peritonitis, caused by the worms boring into the intestine.

The symptoms in young cattle are, a husky cough (giving rise to the name Husk) staring coat, a run-down condition and, in the last stage, a swelling under the jaw. The animal may appear to be suffering from a cold or diarrhoea.

TREATMENT.

There are various remedies, but as one writer puts it, there is no easy way out of the trouble, nor a home-made remedy that will penetrate the bronchial tube and hunt down the worms that cause it. The best way is to attempt both preventive and curative means at the same time, for there is no use treating stock medicinally and then turning them out to an infected pasture. All infected animals must first be segregated and treated medicinally, while the infected pastures are treated with salt and soot. This is considered the best treatment but as soot cannot be easily obtained in Trinidad, 10 cwt. per acre of salt may be applied, and if this is followed by the same quantity of lime sometime afterwards, good results will be obtained.

In the treatment of animals, all the stock should have a liberal allowance of medicated salt, or *medico* given as medicated salt. *Medico* is a vermifuge prepared by Messrs. Cooper and Nephews of Coopers Dip fame and sold by their agents in Trinidad, Messrs. T. G. Grant, Ltd., in

5 lb. packages, one package is mixed with 70 lb. salt 1 lb. of Medico with 14 lb. of salt. In addition to medicated salt, Medico can be given to infected animals in balls commencing with one tea-spoonful to young animals and increasing the dose to two or even more for larger animals. Besides being a very good vermifuge it is also an excellent tonic.

Young stock should not be turned out to pasture until the sun is up and the dew off the grass when the parasite leaves the tips of the grass and returns to the roots and burrows in the ground.

For animals affected, a very good remedy is 1 oz. extract of male shield fern, 8 oz. liquor arsenicalis, 6 oz. oil of turpentine, 20 oz. castor oil. Dose 4 to 8 oz. of the mixture for calves according to age, and 12 oz. for a full grown animal, to be repeated every seven days until improvement is shown.

Another remedy that has given good results at the Government Farm is fumigation. The animals are put in a comparatively air tight chamber in which a pound or more of sulphur is placed in a pot or fire proof saucer, saturated with methylated spirit and set alight. The animals are kept in the sulphur fumes from three to five minutes, but great care must be taken not to over do it otherwise the result will be fatal.

With badly infected cases the most effective remedy is the injection into the windpipe, with a hypodermic syringe of 2 drachms oil of turpentine, 20 drops carbolic acid, 30 drops chloroform. There is no special art in performing this operation, but stock-breeders who have not the knowledge should get a Veterinary Surgeon to instruct them in the use of the hypodermic needle. Next to intra-tracheal injection, a very good remedy for serious cases is $\frac{1}{2}$ a drachm of carbolic acid, $\frac{1}{2}$ an oz. of terpentine, 2 drachms tincture of assafetida, 7 oz. linseed oil, to be given as a drench, after fasting over night and until an hour after the medicine has been given. This dose can be repeated two or three times at intervals of four or five days.

There is no doubt that our native wild animals are infected to a certain extent and may be one of the sources of infection for sheep, goats, cats and dogs; also the wild birds may infect poultry, but as wild animals and birds have a wide range over which they feed the infection from that source is not to be considered as serious.

A statement is appended showing the deaths amongst cattle at the Government Farms from *Strongylus* or diseases that may be suspected as *Strongylus* since first diagnosed in 1897.

STATEMENT SHOWING DEATHS OF CATTLE AT GOVERNMENT FARMS.
TRINIDAD AND TOBAGO FROM STRONGYLUS OR DISEASES THAT MIGHT
BE SUSPECTED AS STRONGYLUS.

Year.	Location.	From Strongylus.	DISEASES THAT MAY BE SUSPECTED AS STRONGYLUS					Other Diseases, Accidents, &c.	Total Deaths.
			Peritonitis.	Pneumonia.	Scour.	Diarrhoea.	Dysentery.	Eating Dirt.	
	St. Clair	.	.	..	..	.	..	2	2
1897	.. "	..	1	6	..	.	.	7	14
1898	.. "	..	..	..	..	8	..	5	13
1899	.. "	..	..	..	..	4	..	4	8
1900	.. "	..	..	..	..	..	8	2	10
1901-2	.. Valsayn	..	..	..	..	8	..	2	10
1902-3	.. "	..	17	..	..	12	..	1	30
1903-4	.. "	..	48	..	..	19	..	17	84
1904-5	.. "	..	..	1	5	1	..	9	16
..	.. Tobago	..	..	..	1	2	..	5	8
1905-6	.. Valsayn	..	24	..	..	.	..	4	28
..	.. Tobago	..	3	..	..	..	..	5	8
1906-7	.. Valsayn	..	15	..	..	.	..	10	25
..	.. Tobago	..	2	..	..	..	..	6	8
1907-8	.. Valsayn	..	19	..	..	.	..	8	27
..	.. Tobago	..	2	..	..	..	..	6	8
1908-9	.. Valsayn	..	4	..	..	..	..	4	8
..	.. Tobago	..	7	..	..	..	..	..	7
1909-10	.. Valsayn	..	7	..	..	.	..	6	13
..	.. Tobago	..	7	..	..	..	..	6	13
1910-11	.. Valsayn	..	43	..	..	..	..	10	53
1911-12	.. "	..	23	..	20	..	..	8	51
1912-13	.. "	..	29	..	20	..	..	10	59
1913-14	.. "	..	10	..	..	..	..	6	16
1914-15	.. "	..	31	..	..	..	..	10	41
1915	.. "	..	5	..	..	..	..	4	9
1916	.. "	..	32	..	..	..	..	7	39
1917	.. "	..	13	..	..	..	..	3	16
	Total	..	342	7	46	54	8	167	624

Notes on *Strongylus* Nematodes.

By H. MEADEN,

Manager. Government Farm, Tobago.

These parasites first came prominently into notice at the Government Farm Valsayn, Trinidad in 1902 when several yearling and adult cattle became infected. The outbreak of disease was at first unaccounted for until at two postmortems *Strongylus* parasites were found in large numbers in the lungs, bronchi and stomachs. As we now have much more information on these parasites it is quite evident that taking well bred and carefully used animals from the institutions and well kept pastures of St. Clair Farm (now that beautiful residential quarter of Port-of-Spain) and placing them on rough old abandoned sugar cane land with a rank growth of scrub and large open drains which were more or less clogged with a growth of coarse grass and stagnant water was the cause of the trouble, firstly the cattle undoubtedly became infected by drinking water out of these drains; no water was then laid into the Farm from the reservoir, then grazing the grass off damp and low-lying pastures which were frequently flooded in the wet season helped to spread the parasites; then again the drinking water was contaminated with sewage from the town of St. Joseph which ran through most of the pastures of Valsayn. The continued use of this water would account for almost every imaginable disease possible.

Whilst the Farm Stock at Valsayn was suffering severely from *Strongylus* infection it was also known that the Caroni, Tacarigua and Couva districts had it badly also, but probably most of the losses were put down to something else.

The animals affected were not confined to stock bred from European bulls; all classes of stock suffered badly, even the hardy pure bred Zebu; at the first outbreak many of these hardy animals went down.

In Tobago the Farm cattle suffered from the same parasites. The sheep I found on my arrival at the Tobago Farm in 1905 were also suffering from parasitic attacks. Arrangements were made to graze the cattle on the hill lands and a pure water supply was laid down. The animals soon showed signs of improvement, proving conclusively that infection was due to animals being allowed to graze over swampy land with an impure water supply.

Three places in Tobago with low-lying lands, widely separated and with no history of exchange of stock have suffered from parasitic attacks, and strange to say one of these places contained a goodly quantity of salt grass grazing which should make parasitic attacks impossible. I attribute the infection to the water supply in each case; mud ponds or drains should be avoided.

From observations made over a number of years as Inspector of Meat in Tobago, I have not found two cases of Lung worm in cattle. This good record is no doubt due to the fact that most cattle slaughtered are purchased from the peasantry who from a business point of view generally pick out the best bit of grazing ground be it theirs or otherwise on which to tether their stock, and that the animals are generally carefully watered at a river. A couple of cases of Nodular Disease (*Oesophogostoma* sp. in the cæcum and small intestines being sold as

tripe have come under my notice and condemned; on enquiry both cases again widely separated proved that the drinking water was bad.

Sheep have frequently been found with Lung worms and stomach worms. *Oesophagostoma Colombianum* the cause of nodular disease in the intestines has also been found in sheep and goats.

More than 75 per cent. of the pigs slaughtered in Tobago are found with Lung worms, and about 90 per cent. are affected with Kidney worm the normal habitat of which appears to be the fatty tissue enveloping the kidney, though I have found them in the liver in bad infestations. These worms are generally found in small cysts containing two or several specimens.

Mention is made in a few authorities of some types of deer, the hare, rabbit and chamois suffering from *Strongylus* but they are frequently of a distinct type from those affecting cattle, sheep and horses, and I exclude the theory of an epidemic of *Strongylus* such as we had at the Valsayn Farm in Trinidad in 1908 being at all likely to be due to wild animals. In the first place there are very few wild animals anywhere round that district. Of course it would be very interesting to hold post-mortem examinations on any wild animals to find out if they contained parasitic life. I am afraid Tobago does not lend itself to such an undertaking as the island is practically denuded of wild animals.

LUNG-WORMS.

A period of two months generally elapses after infection before symptoms are noticed although manifested throughout the year, the disease is seen in its severest stages, after heavy rainy seasons. The first symptom is bronchitis which becomes more severe as time goes on; the cough is hard, then softens and finally attacks the animals in paroxysms, there is a frothy discharge from the nostril and mouth, distressing swelling under the jaw, giving a dropsical appearance and the eyes sink in with frequent tear streams. Stomach worms very often co-exist. Young and old animals suffer most.

STOMACH WORMS.

There are anaemia and emaciation both of a gradually increasing type, the coat stares and patches of hair come away. Swelling of the throat, diarrhoea, loss of flesh and weakness become marked and on urging the animals to move they do so in a limp and unsteady manner. Anaemia is shown by pallidity of the visible mucous membrane, appetite varies the animal sometimes eating ravenously and at other times lying without any effort to eat. When the head is turned the white of the eyes attracts attention. Diarrhoea is no always constant in degree. After a protracted and varying period the emaciation becomes aggravated and death ensues. The temperature, pulse and respiration are not much disturbed.

TREATMENT.

Treatment is as a rule generally unsatisfactory, unless the disease is coped with in the early stages. Formerly antiseptic expectorants principally turpentine and linseed oil, were often given by way of the alimentary tract. Fumigation has been practiced, the principle being to generate a good supply of chlorine gas, sulphur, tar or tobacco

fumes in a closed building containing the animals. The irritation caused by the gas causes the animals to cough up the worms mixed with mucus. The animals are usually kept inhaling the fumes until the attendant can stand them no longer himself. Both methods of treatment have been given up to a large extent in favour of direct medication to the organs affected.

The main thing to be aimed at is to arrest further infection, by segregating all affected animals from healthy ones, to maintain general physical condition, to destroy the lung and intestinal worms and to ward off pneumonia, etc. Plenty of good feeding, on easily digested food, fed dry if possible, of a nitrogenous nature, so as to keep up a good physical condition. Tonics, both vegetable and mineral should be given in the feed to help dislodge intestinal worms and tone up the general health. The addition to the feed of pulped onions has been found of material use.

Intertracheal injections for the lung and bronchial worms are the most satisfactory, though with large numbers of animals such as sheep and calves it might be found too laborious and the inhalation method would expedite matters somewhat, the sheep and calves should have their heads steamed over a large boiler containing a large quantity of oil of turpentine.

Parasitic attacks are known to be practically world wide, and to get ahead of them a campaign should be started on the lines of the Rockefeller Ankylostomiasis or Hook-worm campaign. Infected districts should be surveyed systematically by microscopic examination of sputum and fæces to prove the presence of ova, larvæ or adult worms; free advice should be given as to treatment and methods of sanitation to be adopted and no doubt something in the right direction of eradicating these dangerous pests will have been accomplished.

Preventive measures should be adopted wherever the parasites are known to exist and in cases of low-lying and swampy areas the land should be thoroughly drained. Sub-soil drainage is expensive, but destructive parasites are very much more so in the end. All ponds, pools, and useless dips in the land should be filled in, wet portions of land undrainable should be fenced off, to prevent stock obtaining access. Where there is no high ground or hill pasture obtainable, it is better to pen the stock on the driest portion and trough feed them, never forgetting to burn all fæces, bedding and thoroughly to disinfect all troughs and water receptacles when cleaning up. A liberal quantity of feed and salt should be given to the stock, remembering always that an insufficient supply of food pre-disposes the animals to attack and after attack lessens their chances of recovery.

The water supply, which is considered one of the principal sources of infection, should be pure and clean. Stagnant water and filthy ponds should be carefully avoided.

Manure and refuse from pens containing fæces should be destroyed and not spread about grazing areas.

A pure water supply, good feeding combined with the destruction of all infected fæces to prevent contaminating the water and savannahs would certainly bring most parasitic diseases under effective control.

In most of the species a lot remains to be found out about their life cycle. In parasitic-bronchitis, the worms, eggs and embryos are expelled in great numbers from the mouth and nostrils through irritation caused by coughing, a fully grown female passes out several millions of embryos. this vast number must necessarily find their way to the soil.

The conditions most favourable for infection are an impure and infected water-supply, over crowding of animals on pastures, insufficient food, a debilitated condition, low-lying and swampy pastures, infected food, heavy wet seasons favour the development of the worms. Pigs that have never left their pens are sometimes attacked.

The preventive measures may appear simple in theory but are often attended by practical difficulties. The eggs cannot develop on dry land; removal to dry savannahs or hillsides is thus naturally indicated. Removal to dry sites is often fraught with rapid improvement, but still the old infected pastures remain, these if possible should be ploughed up and planted with food crops such as corn peas, potato, &c., a tractor plough would here be useful. The cropping of old pastures should be maintained for two years if practicable, three would not be too much, then thoroughly drain both by surface and sub-soil drainage, when practicable. The drainage must be done with no other point in view but thoroughly drying the pastures; the natural outfalls of the land must be kept in order, clogging in drains removed, all pools and ponds filled up, land incapable of drainage should be fenced off and not used for grazing. Animals should not be allowed to graze early in the morning as the worms are likely to be well up on the blades of grass, as the sun comes up and the grass dries the worms go down again to avoid heat which they cannot stand or any length of time.

A top dressing of either lime or salt to the pastures might help, but the chances of bringing the lime or salt in contact with the *Cercariae* are doubtful and perhaps it would be better to apply the dressing to areas most likely to contain infection and the dressing should be repeated a couple of times.

The question of eliminating parasitic infection largely hangs on good hygienic and sanitary conditions being thoroughly carried out.

The greater number of Nematodes furnished by the family of *Strongylidae* are capable of producing considerable havoc among cattle, sheep and horses as these destructive parasites are found in the respiratory, circulatory and digestive apparatus and as a rule give great trouble to dislodge not infrequently causing death immediately after any attempt to give medicine. Little can be done against the greatest culprits—viz., the encysted bowel forms. Powders containing Santonin, gentian, aniseed, antimony, iron sulphate and potassium tartrate can be given. Thymol and eucalyptol in glycerin, spirit and mucilage can be given with some success. It is stated that good results have been obtained by the use of subcutaneous and intravenous injection of Atoxyl in 15 to 20 grain doses, of course this treatment is directed against immature forms.

Intratracheal injections are probably the most satisfactory and convenient in experienced hands. The following prescriptions are most in use for calves:—

1. Take—

Oil of Turpentine	...	...	2 drachms.
Tincture of Opium	...	...	1 drachm.
Liquid Carbolic Acid	...	...	20 minims.
Olive Oil	...	...	2 drachms.

Mix for one injection, to be injected into the windpipe or trachea every second or third day—with regard to the severity of the case, &c.

2. Take—

Oil of Turpentine	} Of each three (3) ounces.
Tincture of Opium	...	..
Liquid Carbolic Acid	...	...
Water	...	...

Mix and inject into the windpipe or trachea half an ounce as a dose.

3. Take—

Oil of Cloves	...	..	} Of each (3) three ounces.
Oil of Turpentine	...	...
Olive Oil	...	...	} Of each (2) two drachms.
Carbolic Acid	...	...

Mix and use two drachms as a dose to be injected into the windpipe.

4. Take—

Creosote	...	...	One drachm.
Rectified Spirits	...	...	} Of each (six) 6 ounces & (two) 2 drachms.
Water	...	...

Mix dose about 3 (three) drachms to be vaporised into the windpipe on three consecutive days.

5. Take—

Creolin	...	...	55 minims or drops.
Oil of Turpentine	...	...	} Of each 3 (three) ounces.
Olive Oil	...	...

Mix and inject 2½ (two and a half) drachms daily for three days into the windpipe.

6. For sheep Monssu recommends—

Iodine	...	...	1 part.
Potassium Iodide	...	...	5 parts.
Water	...	...	50 parts.

This solution is mixed with equal parts of olive oil and oil of turpentine. Dose 1½ to 2½ drachms, to be injected into the windpipe on two consecutive days. Will often greatly relieve the symptoms.

7. Take—

Oil of Turpentine	...	...	2 drachms.
Carbolic Acid pure	...	...	20 minims or drops.
Chloroform	...	...	80 " "

Cooper & Nephews "Medico" a highly concentrated worm destroyer, mixed with salt as directed by the firm, gives excellent results at small cost, it is reputed to contain five absolute worm destroyers, besides other drugs acting upon the digestive system, which stimulates and keeps up health and vigour.

FORESTRY.

PROPERTY MARKS FOR TIMBER.

Rules made by the Governor under Section 23 (b) of the Forest Ordinance, 1915, (No. 42 of 1915).

Council Paper No. 127 of 1918.

J. R. CHANCELLOR,

Governor.

1. Registration of a property mark shall be effected at the office of the Conservator of Forests, who may in his discretion refuse to register any property mark on account of its similarity to any existing mark or for any other reason which to him may seem sufficient. Copies of all property marks registered shall be sent by the Conservator to the Wardens.

2. A registered property mark shall, so long as it is covered by an unexpired license to carry and use the same, be available for use on any Crown Land within the Colony.

3. Registration of a property mark shall hold good from the date of such registration until the following 31st day of December and for the next succeeding two years.

4. A registered property mark may be borne by one or more hammers. When such mark is borne by more than one hammer, each hammer after the first shall bear in addition to the registered mark a serial number beginning with 2, to denote that it forms one of a series of hammers bearing the same mark. No additional registration fee shall be payable in respect of such additional hammers bearing the same mark, but any other modification or alteration in the form of such mark shall be separately registered.

5. Fees for the registration of property marks shall be as follows :—

For each new mark registered ...	...	£ 1 0 0
For each year for which such registration is extended or renewed ...	...	5 0
For the transfer of any mark ...	...	10 0

6. Every renewal or extension of the registration of a property mark shall commence from the date of expiry of the original registration or of any subsequent renewal or extension.

7. The Conservator of Forests shall, on registering a property mark, grant to the owner thereof a certificate in the form set out in the Schedule to these Rules.

8. No registration or renewal of the registration of a property mark shall be granted until the fees payable in respect of such registration have been duly paid.

9. Whoever

- (a.) marks any standing tree or any timber on Crown Land with a marking hammer or other implement for impressing marks on timber other than a property mark registered under these Rules and covered by an unexpired license granted by a duly authorised Forest Officer; or

(b.) impresses any such property mark on any tree or timber on Crown Land save under the authority of a duly authorised Forest Officer; or

(c.) alters, defaces or obliterates any such registered property mark placed on any tree or timber under the authority of a duly authorised Forest Officer

is liable on summary conviction to a penalty not exceeding £10 or in default to imprisonment with or without hard labour for a term not exceeding two months and in addition to such punishment, the registration of his property mark may be cancelled.

Made by the Governor this 25th day of October, 1918.

SCHEDULE.

CERTIFICATE OF REGISTRATION OF A PROPERTY MARK UNDER THE FOREST ORDINANCE No. 42 OF 1915.

I certify that I have on this.....day of.....19...registered the property mark of.....of.....the design of which is shown on the back thereof.

The registration of the property mark expires on the19...

Forest Office,

.....19...

.....

Conservator of Forests.

Approved by the Legislative Council this Fifteenth day of November, 1918.

J. M. FARFAN,
Acting Clerk of the Council.

AGRICULTURAL CREDIT SOCIETIES.

Registration Notices.

(From *Trinidad Royal Gazette*, Vol. 87, p. 1879. December 19, 1918).
Registered No. 5.

I hereby certify that application for the registration of the Moriah (Tobago) Agricultural Credit Society whose office or place of business is the Moriah Moravian School Room, has been made by Mr. T. L. Stephenson, Secretary, and that the above Society has been duly registered under the Agricultural Credit Societies Ordinance, No. 30 of 1915.

December 16, 1918.

W. G. FREEMAN,
Registrar (Acting).

Registered No. 6.

I hereby certify that application for the registration of the Mason Hall (Tobago) Agricultural Credit Society, whose office or place of business is Shade's Place, Mason Hall, has been made by Mr. Amos Paul, Secretary, and that the above Society has been duly registered under the Agricultural Credit Societies Ordinance, No. 30 of 1915.

December 16, 1918.

W. G. FREEMAN,
Registrar (Acting).

METEOROLOGY.

RAINFALL RETURN- OCT., TO DEC., 1918.

Stations.	Oct., 1918.	Nov., 1918.	Dec., 1918.	January to Dec., 1918.	January to Dec., 1917.
<i>North-west District.</i>					
St. Clair—Royal Botanic Gardens ...	Ins. 5.31	Ins. 7.56	Ins. 3.85	Ins. 63.03	61.24
Port-of-Spain—Colonial Hospital ...	4.63	4.96	2.86	49.38	53.92
" Royal Gaol ...	4.95	5.22	3.21	56.03	56.87
" Constabulary Headquarters ...	5.77	5.96	2.64	49.76	54.75
St. Ann's—Reservoir ...	7.50	7.84	6.20	82.60	80.76
Maraval—	11.49	6.23	5.39	76.97	74.98
" Constabulary Station ...	11.55	6.80	5.87	81.27	86.78
Diego Martin—Constabulary Station ...	11.26	5.69	5.25	80.79	86.18
" Waterworks ...	9.45	4.98	4.71	72.70	74.50
" River estate ...	8.99	4.25	4.30	71.97	69.91
Fort George Signal Station ...	8.12	5.48	3.07	67.83	63.80
North Post ...	5.47	3.08	2.79	67.83	57.14
Carenage Constabulary Station ...	10.36	6.76	3.49	76.30	79.59
Carrera Island Convict Depot ...	2.24	1.80	1.42	21.06	22.33
Chacachacare Lighthouse ...	3.61	7.13	3.44	53.96	51.22
<i>Santa Cruz—Maracas District.</i>					
Santa Cruz—Constabulary Station ...	10.04	6.47	6.10	84.36	96.00
St. Joseph—Government Farm ...	6.22	6.37	3.95	60.84	64.63
" Constabulary Station ...	4.82	4.39	2.89	47.51	56.77
Tunapuna—St. Augustine estate ...	5.73	4.27	3.83	56.76	58.30
Maracas—Government School ...	10.05	5.86	6.09	...	81.72
" Ortinola estate ...	7.20	5.51	5.11	73.43	73.85
" San José estate ...	9.58	6.17	6.34	69.89	...
Caura—Wardour estate ...	6.23	5.18	3.08	61.42	66.62
<i>West Central District.</i>					
Caroni—Frederick estate ...	5.64	7.84	6.82	68.18	61.40
Chaguanas—Constabulary Station ...	3.46	5.54	3.62	35.15	60.78
" Woodford Lodge estate ...	4.13	5.87	4.71	56.39	54.96
Carapichaima—Waterloo estate ...	5.81	6.82	6.04	68.07	64.44
" McBean Cacao estate ...	5.29	6.94	5.31	63.33	50.59
" Friendship Hall estate ...	5.05	7.54	5.21	...	66.25
Couva—Exchange estate ...	...	...	...	...	56.86
" Brechin Castle estate ...	4.83	6.00	5.30	60.00	63.41
" Perseverance ...	...	...	...	...	53.06
" Camden ...	3.92	6.78	...	...	58.61
" Milton ...	4.42	5.63	4.08	61.00	68.34
" Spring ...	8.27	5.47	4.22	62.01	63.69
" Constabulary Station ...	3.93	4.13	2.99	50.81	45.67
" Esperanza estate ...	4.33	5.04	2.55	50.76	57.56
<i>Montserrat District.</i>					
Brasso-Piedra—Mamoral estate ...	7.08	9.34	8.41	87.14	91.85
" La Mariana estate ...	6.40	10.38	8.20	83.83	88.17
Montserrat—Constabulary Station ...	3.74	6.06	5.45	65.23	66.11
Brasso—La Vega estate ...	6.29	9.50	7.58	81.37	92.86
<i>Arima District.</i>					
Arima—Warden's Office ...	9.33	4.90	5.61	80.08	...
" Torrecilla estate ...	11.09	5.72	6.30	92.41	86.56
" Verdant Vale estate ...	8.40	5.93	5.57	70.66	83.43
San Rafael—Constabulary Station ...	8.25	9.70	10.16	91.64	94.62
Guanapo—Talparo estate ...	5.55	7.52	5.84	83.34	101.57
" San José Estate ...	9.55	10.74	8.28	100.67	103.73
Tamana—Sta. Marta estate ...	9.59	11.09	7.67	106.45	127.64
" La Carona estate ...	9.97	10.50	10.55	99.60	109.39
<i>San Fernando & Princes Town District.</i>					
Claixon's Bay—Forres Park estate ...	5.42	5.99	3.18	53.73	55.34
Pointe-à-Pierre—Bonne Aventure estate ...	5.31	4.92	4.92	63.84	82.27
" Concord estate ...	5.94	4.23	2.90	65.09	69.43
" Plein Palais estate ...	7.19	6.35	2.88	59.90	65.36
Naparima—Piston estate ...	6.61	9.00	5.20	65.44	66.11
" Usine St. Madeleine estate ...	6.06	6.91	2.50	63.08	61.56
" La Fortunée estate ...	4.77	6.41	4.47	51.35	61.19
" Tarouba estate ...	4.96	5.47	4.39	46.88	53.18
" Union Hall estate ...	6.40	6.72	5.25	60.53	70.81

RAINFALL RETURN—OCT., TO DEC., 1918.—CONTD.

Stations.	Oct., 1918.	Nov., 1918.	Dec., 1918.	January to Dec., 1918.	January to Dec., 1917.
<i>San Fernando and Princes Town District.—(Contd.)</i>					
Naparima—Palmiste estate ...	6.01	7.95	7.28	69.95	81.98
" Lewisville House ...	6.30	6.85	5.00	70.85	78.64
" Hermitage estate ...	5.22	7.70	5.23	60.56	63.45
" Petit Morne estate ...	...	...	...	...	58.27
Princes Town—Craignish estate ...	9.23	10.69	9.10	81.31	57.12
" Cedar Hill estate ...	9.03	8.01	5.03	70.57	67.67
" Williamsville estate ...	7.62	7.47	5.90	71.89	59.80
" Esmeralda estate ...	4.67	7.70	6.10	82.15	73.07
" New Grant estate ...	9.27	9.11	8.75	88.42	70.29
" Constabulary Station ...	6.11	7.20	5.26	57.71	56.84
" Hindustan estate ...	5.97	9.31	7.88	71.25	60.45
" La Retraite estate ...	8.79	12.22	9.59	103.16	93.95
" Malgretoute estate ...	10.26	9.36	7.03	82.18	64.91
" Friendship & Ben Lomond estates ...	...	...	...	...	66.62
" Los Naranjos estate ...	8.90	11.17	6.61	75.00	72.30
Poole—El Rosario estate ...	8.47	13.91	10.66	100.02	99.24
<i>South-west District.</i>					
Oropuche—Constabulary Station ...	7.85	8.36	6.91	71.41	78.68
" Pluck estate ...	8.89	8.97	7.11	65.38	61.97
Siparia—Constabulary Station ...	10.45	8.65	6.70	77.95	74.98
" Alta Gracia estate ...	10.16	9.38	6.94	84.39	76.67
Guapo—Adventure estate ...	10.80	5.48	5.69	67.30	80.38
Point Fortin—Constabulary Station ...	12.98	6.99	7.12	79.58	96.35
Erin—La Ressource estate ...	2.87	5.37	6.70	47.70	64.30
" La Union estate ...	4.52	7.40	6.01	55.32	69.56
" Industry estate ...	5.80	8.36	5.64	61.24	71.21
Cedros—La Retraite estate ...	13.45	6.43	6.19	77.70	94.94
" Beaulieu estate ...	4.79	6.46	3.93	...	66.10
" Perseverance estate ...	5.63	4.75	3.99	52.34	60.68
" St. Marie estate ...	7.20	5.40	3.78	56.89	72.44
" Constabulary Station ...	7.26	5.78	4.93	55.45	71.09
" St. Quintin estate ...	3.35	4.59	3.75	50.01	65.01
Isacoo—Constance estate ...	1.85	4.25	2.70	110.75	134.59
Irois—Government School ...	12.03	9.80	6.11	72.03	87.54
<i>South Coast.</i>					
Moruga—Constabulary Station ...	5.96	5.99	5.32	60.18	73.47
<i>East Coast.</i>					
Matura—La Juanita estate ...	12.09	8.81	8.41	106.51	106.55
Mauzanilla—Constabulary Station ...	10.77	6.84	5.98	93.61	122.25
" Indrasan estate ...	5.23	9.79	7.74	97.52	...
Sangro Grande—New Lands estate ...	9.89	12.39	11.47	111.64	125.67
" Evasdale estate ...	10.60	10.63	8.46	105.33	111.55
" Grosvenor estate ...	9.99	9.25	8.05	103.96	126.99
" * San Hilario estate ...	10.23	8.09	6.12	91.65	105.83
" San Francisco estate ...	7.68	9.27	7.84	97.39	...
Mayaro—Constabulary Station ...	6.52	7.23	8.59	82.19	89.80
<i>North Coast.</i>					
Blanchisseuse—Constabulary Station ...	7.38	7.13	6.58	87.50	83.27
Grande Rivière—Mon Plaisir estate ...	13.86	12.41	8.32	113.38	100.62
Toco—Arugua House ...	7.74	7.94	4.02	82.47	77.86
" Constabulary Station ...	6.95	6.85	4.27	73.18	83.52
Point Galera—Light House ...	5.29	4.61	2.86	61.07	68.85
<i>Tobago.</i>					
Tobago—Hermitage estate ...	10.50	...	...	...	91.86
" King's Bay " ...	9.58	8.34	4.33	80.37	87.57
" Roxburgh " ...	9.93	8.73	5.67	...	89.22
" Lure estate ...	18.00	9.86	9.01	129.29	75.20
" Botanic Station ...	6.54	4.32	2.70	65.52	67.80
" Government Farm ...	5.47	2.66	2.18	46.92	47.15
" Lowlands estate ...	...	...	...	59.18	50.15
" Friendship " ...	9.59	2.73	2.67	59.18	50.15
" Riversdale " ...	6.43	6.28	5.63	67.39	74.80

* Now "El Recundo Estate."

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE, TRINIDAD & TOBAGO.

Issued by the Department and Board of Agriculture



29132/36

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Editor:

W. G. Freeman.

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DEPARTMENT OF AGRICULTURE.

Agricultural Credit Societies

under Ordinance No. 30, 1915.

Registrar..... W. G. FREEMAN, Director of Agriculture (Acting).*Inspector*..... JOS. E. SEEBULT.

REGISTERED SOCIETIES.

Trinidad. *Date of Registration.*

Diego Martin	...	...	... October	12, 1916.
Lothians	...	...	... April	4, 1919.
Malgretout	...	...	... April	30, 1919.
Petit Morne	...	...	... April	30, 1919.
Union Hall	...	...	... April	30, 1919.

Tobago.

Pembroke	...	...	... June	18, 1917.
Scarborough	...	..	... April	11, 1918.
Delaforde	...	...	... August	26, 1918.
Mason Hall	...	...	... December	16, 1918.
Moriah December	16, 1918.
Charlotteville February	4, 1919.

Plant Protection Ordinance.

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		H. MEADEN.
		L. A. BRUNTON.
<i>Assistant Inspectors</i>	{	J. A. PINDER.
		J. BLACKMAN.
		R. H. LEACOCK (Actg.)

Frog hopper Investigations.

Special Appointment.

C. B. WILLIAMS, M.A., (Camb.) F.E.S.

Reference Library.

THIS Library can be consulted at the Head Office of the Department, St. Clair Experiment Station. It contains standard works on General Agriculture, Horticulture, Botany, etc., and books and periodicals dealing with Cacao, Sugar, Coconuts, Rubber, Cotton, Corn, Fruit, Tobacco, and other crops.

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* On leave for a year from December, 1918.

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Department of Agriculture.

GOVERNMENT STUD ANIMALS.

THE following are the arrangements for May and June with regard to Stud animals of the Government Farms in Trinidad and Tobago.

Stallions.

<i>Name.</i>	<i>Class.</i>	<i>Where standing for Service.</i>	<i>Fee.</i>	<i>Groom's Fee.</i>
QUICKMATCH. Thorough-bred		...Govt. Farm Trinidad ...	\$ 10.00	60c.
SIR HORRY...Thor'gh-bred Hackney		...Govt. Farm " ...	5.00	60c.
SIR HORACE..Half-bred Hackney	Govt. Farm " ...	5.00	60c.
BILLINGTON SPARTAN..Cleveland Bay		...Picton Estate, San F'do	5.00	60c.
MARAT ...Thorough-bred		...Bon Accord, Tobago ...	4.80	60c.

Jack Donkeys.

Monarch ...American Donkey		...Williamsville	... \$ 5.00	60c.
President ... Do. do.		...Govt. Farm, Tobago...	5.00	60c.
Barbados Joe.Jack Donkey		...Breachin Castle Est., Couva.		

Bulls.

A.—AT GOVERNMENT FARMS.

TRINIDAD.

TOBAGO.

<i>Class.</i>	<i>Fee.</i>	<i>Class.</i>	<i>Fee.</i>
2 Pure-bred Zebu ...	\$ 1.20c.	1 Pure-bred Shorthorn ...	\$2.40
1 " Jersey ...	2.40c.	1 Pure-bred Zebu ...	1.00
2 Half-bred Red Poll ...	1.20c.	1 Half-bred Guernsey ...	1.00

B.—AT PUBLIC PASTURES OR ESTATES.

<i>Place.</i>	<i>Class.</i>
Queen's Park Savannah	1 Half-bred Shorthorn; 1 Half-bred Holstein.
Mucurapo Pasture	1 Half-bred Shorthorn; 1 Half-bred Guernsey.
St. Augustine Estate	2 Half-bred Holstein; 1 Half-bred Guernsey.
River Estate	1 Half-bred Zebu;
San Fernando	1 Pure-bred Holstein; 1 Half-bred Jersey.
Harmony Hall Estate	1 Pure-bred Shorthorn.
Arima	1 Half-bred Jersey.
Tobago, Friendship Est.	1 Half-bred Holstein.

Pigs.

AT GOVERNMENT FARM, TRINIDAD.

White Yorkshire, Berkshire, Tamworth	... Fee \$1.00;
Attendant's Fee	25c.

AT GOVERNMENT FARM, TOBAGO.

Berkshire	... Fee 50c.
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POULTRY.

GOVERNMENT FARM, TRINIDAD.

Eggs of Barred Plymouth Rocks, Black Minorcas, Brahmas (light), Rhode Island Reds, White Leghorns	... \$1.00 per doz.
Great Kind Pigeons	... 40c. and 60c. per pair.

GOVERNMENT FARM, TOBAGO.

Eggs of Plymouth Rocks, Black Minorcas, Rhode Island Reds 48c. per doz.
Also Cocks and Pullets of Plymouth Rocks and Rhode Island Reds.

Department of Agriculture.

NURSERY STOCK.

Orders for Oranges, Grape Fruit, and Grafted Mangos for this year should be sent in without delay addressed to the Acting Superintendent, St. Clair Experiment Station, or to the Officer in Charge Botanic Station, Tobago.

Special quotations at St. Clair for Cacao, Coffee and Limes grown from selected seeds are as follows:—

Plants purchased in lots of 1 to 1,000 plants 3 cents per plant.	} Delivered at Nurseries uncrated.
Plants purchased in lots of several thousands 2½ cents per plant.	
Plants purchased in lots up to 100 at 4 cents per plant.	} Delivered at Railway Station, Port-of- Spain or Queen's Wharf, securely packed in open crates.
Plants purchased in lots up to 1,000 at \$8.50 per 100.	
Plants purchased in lots of several thousands at \$88.00 per 1,000.	

Tobago prices on application at the Botanic Station, Scarborough.

Budded Avocado select varieties at 12 cents, Budded Oranges at 24 cents and Grafted Mangos at 24 cents should also be booked at once.

Budded Cacao 12 cents each or in lots of over 100 at 8 cents.

Limes from beds 1½ cents per plant for lots over 100.

A select stock is also kept of other fruit, ornamental and flowering trees, palms, etc., a list of which can be obtained on application. Large orders must be booked six months previous to the date when the plants are required as large supplies are not kept on hand for casual demands.

Board of Agriculture.

SPRAYING CACAO, &c.

From September to November is the time for spraying cacao trees for the prevention of thrips and black rot; and early in the dry season for the Algal disease, die back, and cacao beetles.

The Board of Agriculture has on hand a supply of bluestone, which is sold to planters at 14½ cents per pound, also nicotine sulphate the best insecticide for thrips, which is sold at \$10.70 per gallon.

Men will be provided to superintend any spraying work which estates may wish to have done.

Further information in regard to cost of spraying, etc., and applications for bluestone and nicotine sulphate should be made to

THE SECRETARY,
Board of Agriculture,
Port-of-Spain.

PUBLICATIONS FOR SALE.

THE BULLETIN issued quarterly, price sixpence per number, or two shillings per annum post free in the Colony. To other subscribers postage extra.

Part 1. 1918.—Report on St. Lucia Lime Factory. Storage of Black-eye Peas (Illustrated); Fruits of Trinidad and Tobago; Uses and culture of Dasheens (Illustrated), Prize Competition Reports; etc., etc.

Part 2. 1918.—Coffea excelsa; Yam cultivation; Insects affecting Vegetables; Rubber Tapping Experiments; Tobago Orchids, etc.

Part 3. 1918.—Agricultural Co-operation in the West Indies; Agricultural Credit Societies; Sugar Cane Experiments; Trinidad Thrips, etc., etc., etc.

Part 4. 1918.—Cassava Experiments 1916-18. Food of the Mongoose. Rats and Mongoose. Strongylus in Cattle, Sheep, Goats, &c.

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ANNUAL REPORTS, DEPARTMENT OF AGRICULTURE, 1916 AND 1917.—Price 1s. 9d. each.

All publications can be obtained from the Head Office of the Department, St. Clair Experiment Station, and sent post free within the Colony.

The Bulletin is also on sale at Messrs. Muir, Marshall, and Davidson & Todd, Port-of-Spain.



WITHER-TIP DISEASE OF LIME

BULLETIN
OF THE
DEPARTMENT OF AGRICULTURE
Trinidad and Tobago.

PART 1.]

[VOL. XVIII.]

LIMES.

THE WITHER-TIP OF LIMES.

BY JAMES BIRCH ROBER,
Mycologist, Board of Agriculture.

With One Plate.

DURING July and August, 1918 there was a severe outbreak of a disease of lime trees throughout the colony, practically all districts being equally affected. Specimens were received from a large number of different estates, and all showed "wither-tip" in its characteristic form. This is one of the commonest and most destructive diseases of limes, though heretofore, it has not been very prevalent in Trinidad. It is due to the fungus known as *Glassporium limeticolum*, Clausen. The fungus is able to attack the young growth of lime plants of all ages; in fact, at the St. Clair Experiment Station it has caused the death of a great many nursery plants of from six inches to a foot high, during the past two years. ⁽¹⁾

APPEARANCE OF THE DISEASE.

The attacks of the fungus generally show on the tips and edges of the very young leaves, but they affect also the leaf stalk, at the point where the leaf joins the stem, or any point in the very young shoots. The first sign of infection is indicated by a somewhat water-soaked appearance until the young leaves and tip of the shoot are entirely destroyed. If the weather is not so damp, the water-soaked appearance is not so pronounced, but the attacked part is light green in colour at first, and then become brown. In all cases, the affected shoots wither up, thus giving the popular name of the disease. When the larger young leaves are affected they often become curled and distorted and the infected areas drop out or become cracked, so that the leaf is punctured with holes. Only young growing leaves and the young shoots apparently can be attacked by the fungus; leaves and shoots that have become hardened and matured are quite immune to the disease.

(1.) This disease must not be confused with the "Damping-off" disease which is very severe on seedlings when they are from one to three inches high, and which has already been described in the *Proceedings of the Agricultural Society*, XV, 1915, 14-15. "Wither-tip" generally attacks the plants when they are a little older.

In addition to the leaves and the tender shoots, the flowers⁽¹⁾ and young fruit are very susceptible to attack, and on this account, the disease causes a great loss of fruit. If the flowers are attacked, they fall from the tree without setting fruit. When young fruits are attacked, they show a rough scabby appearance and become cracked, and generally fall from the tree in two or three weeks.

After the fruits have become half-grown, they seem to be immune to further attack. Full-grown fruits, after having fallen to the ground, however, may be attacked through wounds, and the fungus in this way, probably causes a good of rotting of the fruit from the time of gathering until it reaches the factory.

TREATMENT OF THE DISEASE.

As this disease became epidemic last year, it is quite probable that under favourable conditions, it may do even more damage this year, and every one should be prepared to combat it. Fortunately, it is comparatively easy to treat. If possible, all the dead wood and diseased leaves should be collected and burned during the dry season, and as soon as the trees begin to make their new growth after the rains begin, they should be thoroughly sprayed with Bordeaux mixture 4-4-50, to every gallon of which should be added a sticker, made as follows:—

Resin ...	...	...	...	...	2 pounds.
Washing soda (crystals)	...	...	...	...	1 pound.
Water ...	...	...	...	...	1 gallon.

Mix, and boil until the preparation is a clear brown, about one hour. This will make the Bordeaux spread and stick to the glossy surface of the lime leaves. After the first application has been made, the trees should be watched very carefully as time goes on, to see whether or not the new growth is becoming infected. If infections are found, it would be advisable to make another application of Bordeaux mixture. The number of applications necessary can only be judged according to the climatic conditions throughout the growing period.

NOTES ADDED.

The above article was written by Mr. Rorer before he left for Ecuador. The following notes are also of interest.

In the *Report* of the Porto Rico Agricultural Experiment Station for 1917, pp. 29-30, reference is made to what is apparently the same disease:—

"The wither-tip fungus (*Colletotrichum gloeosporioides*) has been quite active during the past year, partly because of lowered vitality in the trees from lack of fertilizer. A few cases have been noted in which the initial injury results from poor drainage, impervious subsoil, or use of sprays. The damage done by this fungus to vigorously growing trees is very slight."

In the course of a visit paid on one day by Mr. Ulrich and myself to three lime estates in Trinidad, with very similar climatic conditions,

(1.) The disease is for this reason also known as Blossom-blight. (Ed.)

it was noticeable that the disease was much more marked in places where the cultivation was poor. Thus on one estate the older trees which have been in an abandoned condition for several years were badly affected, whilst close by young trees under good cultivation showed no sign at all of the disease.

In order to guard against the introduction of the disease into lime producing islands in which it is not at present known, Proclamations have been issued in the Colonies of the Leeward and Windward Islands prohibiting the importation of all Citrus plants and parts of Citrus plants, including their fruits, from all parts of the West Indies excepting those free of the disease *e.g.* Antigua prohibits importations from British Guiana or any island or place in the West Indies except the islands of Dominica, Montserrat, St. Lucia and Grenada.

W.G.F.

FOOD CROPS.

EXPERIMENTS ON YAM CULTIVATION,

St. Clair Experiment Station, 1918-19.

By R. O. WILLIAMS,

Acting Supt., Royal Botanic Gardens and St. Clair Experiment Station.

As reported in *Bulletin* XVII, 1918, p. 69 a planting distance experiment for yams has been carried out.

Ten trenches each 200 feet long and 4 feet apart were dug 2 feet in breadth and about 18 inches in depth. These were filled partly with trash and partly with cow manure, then covered and banked up with soil in the usual way.

The plants used weighed approximately $\frac{1}{2}$ lb. each and two of the trenches were planted at 1 foot apart, two at 15 inches, two at 18 inches, two at 21 inches and two at 2 feet. The planting was done during the month of April, 1918 and the crop reaped during January, 1919.

The labour was performed by a prison gang, but to enable one interested in cultivation of this kind to get an idea of the cost of labour, &c., and the profits to be derived from it, I will take the cost of cultivation in trenches four feet apart and of the same dimensions as worked out at St. Augustine under estate conditions in 1917-18. These were published in an article by the Superintendent of Field Experiments in *Bulletin* XVII, 1918, 66.

It will be noticed that in this experiment the only difference in the cost of cultivation between wide and close planting is due to more plants being required and a little more labour in planting, as all trenches are four feet apart and cost the same to prepare.

The cost of cultivation and of yams used for planting if calculated on this basis would be for the ten trenches \$44.51, and the value of the crop reaped at two cents per lb. \$122.42, making a profit on the whole experiment of \$77.91.

As will be noted from the table given below, this experiment has shown that planting 15 inches apart in the rows has given the best return as whereas the 4 ft. by 2 ft. gave a profit of \$9.98 per 1,600 square feet of land, 4 ft. by 1 ft. 9 in. \$10.05, 4 ft. by 1 ft. 6 in. \$16.61, 4 ft. by 1 ft. 3 in. gave \$21.37 and 4 ft. by 1 ft. \$19.95.

Planting distance.	Number of plants planted.	Number successful.	Average per hole from successful plants.	Total crop.	Value at 2 cents per lb.	Cost of cultivation and plants.	Net profit.
				Lb.	\$ c.	\$ c.	\$ c.
4 ft. x 2 ft. ...	200	188	4.9 lb.	921	18.42	8.49	9.93
4 ft. x 1 ft. 9 in.	228	214	4.3 "	934	18.68	8.63	10.05
4 ft. x 1 ft. 6 in.	266	232	5.5 "	1,271	25.42	8.81	16.61
4 ft. x 1 ft. 3 in.	320	301	5.0 "	1,523	30.46	9.09	21.37
4 ft. x 1 ft. ..	400	363	4.0 "	1,472	29.44	9.49	19.95
				6,121	122.42	44.51	77.91

To the small planter who wants to know what he can reasonably expect with good cultivation from an ordinary "lot" 100 ft. by 50 ft.; *i.e.* 5,000 sq. ft. planted at 4 ft. by 15 in. he could work out his estimate as follows:—

Value of crop ...	...	...	...	\$66.78
Cost of cultivation and plants	...	...	...	28.40
Profit	...	...	...	<u>38.38</u>

To the larger planter who requires to reckon in acres, it may be added that, provided the conditions of soil &c. be the same over the whole area cultivated, the crop as calculated from that reaped at the distances under trial would be approximately:—

11·20 tons per acre on the	...	...4 ft. x 2 ft.
11·32 " "	...	...4 ft. x 1 ft. 9 in.
15·49 " "	...	...4 ft. x 1 ft. 6 in.
18·51 " "	...	...4 ft. x 1 ft. 3 in.
17·89 " "	...	...4 ft. x 1 ft.

These yields are very similar to those obtained at St. Augustine last year.

The total crop reaped at St. Clair during last season from all kinds of Yams and under different methods of cultivation amounted to 17,382 lb. or an average of 4·4 lb. per yam reaped: 11,558 lb. of the crop was sold at 2 cents per lb. = \$231.06, and 1,201 lb. at 3 cents = \$36.03; total value \$267.09. The balance, 4,578 lb., was reserved for planting. The cost of cultivation and reaping, including yams for plants, can be reckoned at about 3 to 4 cents per plant at 15 in. apart and as the average yield per plant was 4·4 lb., worth at 2 cents per lb., about 9 cents, there is a profit of 5 to 6 cents on each yam.

EXPERIMENTS FOR 1919-20.

An experiment has been laid out this year to test whether there is any advantage in selecting large yams for planting. A small area has been planted from:—

- (1.) $\frac{1}{4}$ lb. plants cut from large tubers averaging 8 lb. each.
- (2.) Whole small tubers averaging $\frac{1}{4}$ lb. each.
- (3.) Aerial tubers averaging 2½ oz. each.

The varieties obtained from Barbados last year and varieties collected from other sources in the past are being tested on a larger scale than was possible before.

C A C A O .

NITROGEN CONTENTS OF CACAO SOILS PLANTED WITH & WITHOUT BOIS IMMORTEL SHADE.

By JOSEPH DE VERTEUIL, F.I.C., F.C.S.,
Superintendent of Field Experiments.

At a meeting of the Cacao Committee of the Board of Agriculture, held in December, 1917, Mr. W. C. Jardine asked that the nitrogen contents of the soil be determined, in the Full and No Shade plots of Field 5, River Estate, at the end of March, June, September, and December respectively. The object of these analyses is to ascertain whether there is a larger amount of nitrogen and nitrates in the soil where the cacao trees are shaded with bois immortal (*Erythrina* spp.) than where there is no immortal shade, and therefore whether the immortal trees are beneficial to the cacao trees in producing a larger supply of nitrogen in the soil.

Samples of soil were accordingly taken during 1918 and analysed.

These soils may be described as sandy loams, and their mechanical composition was very similar. The samples contained an average of 91 and 93 per cent. of fine soil and 9 and 7 per cent. of coarse sand for the Full and No Shade plots respectively.

The composition of the air-dried fine soil for each quarter respectively was as follows :—

<i>March, 1918.</i>			<i>Full Shade.</i>	<i>No Shade.</i>
Moisture	...	...	0.84	1.12
Volatile matter and combined water	...	...	3.62	4.82
Mineral matter	...	...	95.54	94.06
			100.00	100.00
<i>June, 1918.</i>				
Moisture	...	...	0.84	0.94
Volatile matter and combined water	...	...	3.48	3.84
Mineral matter	...	...	95.68	95.22
			100.00	100.00
<i>September, 1918.</i>				
Moisture	...	...	1.06	1.06
Volatile matter and combined water	...	...	3.32	3.52
Mineral matter	...	...	95.62	95.42
			100.00	100.00
<i>December, 1918.</i>				
Moisture	...	...	0.92	0.94
Volatile matter and combined water	...	...	4.28	4.04
Mineral matter	...	...	94.80	95.02
			100.00	100.00

The total nitrogen and nitrates were estimated on the air-dried fine soil and the results calculated on the fine soil dried at 100 deg. Centigrade. The figures obtained and the rainfall on the estate are given in the table below.

	Rainfall 1918.	Cacao trees shaded with immortal.	No immortal shade.
Mar. —Total Nitrogen .	Jan.-Feb. 5.49	.081 %	.101 %
Nitrogen as nitrates .	March 1.31	.00093 %	.00062 %
June —Total Nitrogen .	April-May 7.25	.078 %	.096 %
Nitrogen as nitrates...	June 6.94	.00072 %	.00048 %
Sept.—Total Nitrogen ..	July-Aug. 26.71	.084 %	.091 %
Nitrogen as nitrates...	September 6.73	.00062 %	.00042 %
Decr.—Total Nitrogen ...	Oct.—Nov. 13.24	.129 %	.115 %
Nitrogen as nitrates...	December 4.30	.00072 %	.00077 %

From the figures recorded above it will be seen that:—

1. The organic matter, total nitrogen and nitrates decrease during the June and September quarters with the heavier rainfall and increase during the December quarter with the lower rainfall.

2. With the exception of the December sample, the total nitrogen is higher in the No Shade than in the Full Shade plot for each period respectively. But with regard to the nitrates it is just the reverse *i.e.* there are more nitrates present in the Full than in the No Shade plot. Owing however, to the fixation of nitrogen from the air by the bacteria in the nodules of the immortal roots and to the additional supply of nitrogen derived from the immortal flowers, leaves and pods bearing seed, the percentage of organic nitrogen in the soil is practically no less than in the No Shade plot. There is no evidence, however, that the larger amount of nitrates produced in the Full Shade plot is beneficial to the cacao trees as the average yield of the past two years for the Full and No Shade plots respectively, is practically the same as the average of the previous five years.

Another question presents itself and it is this. Is the smaller amount of nitrates generated in the No Shade plot sufficient to produce a maximum crop? As far as can be judged at present the amount of nitrates formed in the No Shade plot appears to be sufficient as the yield from the No Shade plot shows a smaller decrease (408 against 682 pods per acre) during the past two years than the Full Shade plot compared with the average yield of the first 5 years after the shade had been cut out.

The smallest amount of nitrates found, .00042 per cent., was in the September sample for the No Shade plot and it represents what has

not been utilised by the cacao plants or washed out of the soil by the rains. It is so to speak the reserve of nitrates in the soil. This amount although small in appearance represents 10½ lb. of nitrate nitrogen per acre and as a good average cacao crop for the Colony viz. 4 bags per acre, removes from the soil in one year only 14 to 15 lb. of nitrogen, it would appear to be ample for the crop produced, since the formation of nitrates is continuous under favourable tropical conditions such as exist in the field in question. It must not be forgotten however, that a larger amount of nitrogen is required for the production of new wood, leaves and the husks of the cacao pods. This has been estimated by Marcato (1) at 130 lb. per acre per annum. But as the trimmings, leaves and cacao husks are allowed to remain on the soil and decompose they are sooner or later converted into nitrates for the plants' use.

During this process of decomposition there is a small loss of nitrogen which may be estimated at 25 per cent. on 32 lb. per acre, and although there is at present no indication of a shortage of nitrates in the No Shade plot, this may occur later. But before this question can be definitely answered it will be necessary to carry out similar manurial experiments with different quantities of nitrogenous manures on Full and No Shade plots of known bearing capacity *i.e.* on which a record of the *natural* yield has been ascertained.

(1.) *Essais D'Agronomie Tropicale* V. Marcato.

SUGAR.

SUGAR CROP RETURNS 1919.

THE following Sections of the Produce Taxation Ordinance, No. 28 of 1918, specify the returns to be made of the sugar manufactured during 1919:—

Section 7.—(1.) On or before the 15th day of January, 1920 the owner or manager of any sugar factory in Trinidad shall in respect of such factory make a return to the Receiver-General showing the amount of sugar manufactured in such factory during the 12 months ending on 31st day of December, 1919.

(2.) For the purpose of testing the accuracy of any return made to the Receiver-General under this section or of obtaining information in case of failure to make a return any person authorised by the Receiver-General may enter any premises whether forming part of a factory or not and examine all books documents and papers referring to or in any way connected with the business of the factory for the purpose of testing the accuracy of the return or of obtaining information.

(3.) Any owner or manager of a sugar factory who—

- (a.) wilfully refuses or without lawful excuse neglects to make a return under this section, or
- (b.) wilfully makes or causes to be made any false return, or
- (c.) obstructs or impedes any person authorised as in this section mentioned in the exercise of any powers under this section, or
- (d.) refuses or neglects to produce any books, documents or papers as aforesaid or refuses to answer or wilfully gives a false answer to any question necessary for testing the accuracy of any return or for obtaining information as to the amount of sugar manufactured in such factory;

is liable to a penalty not exceeding £500 or to imprisonment with or without hard labour for any period not exceeding six months or to both.

Section 8.—(1.) On or before the 31st day of January, 1920 the owner or manager of every sugar factory in Trinidad shall pay to the Receiver-General the amount of the tax upon the sugar manufactured in such factory due under the provisions of this Ordinance up to and including the 31st day of December, 1919 but after making allowance for the sums paid under Section 4 of this Ordinance in respect of the shipment by him of any such sugar.

(2.) If any sum due under the provisions of the preceding sub-section is not paid on or before the 31st day of January, 1920 such owner or manager as aforesaid shall forfeit the sum of £100 in addition to the tax payable as aforesaid.

REPORT TO THE FROGHOPPER COMMITTEE ON MR. GLASGOW'S SUPPOSED CURE FOR FROGHOPPERS.

By C. B. WILLIAMS, M.A., F.E.S.

Entomologist in Charge of Froghopper Investigations.

At the end of October it was announced in the local papers that Mr. Glasgow, dispenser at Orange Grove Estate, had discovered a cure for the froghopper pest (*Tomaspsis saccharina*). It was said to be a liquid which was poured around the roots of the cane thereby killing the nymphs, destroying the eggs, and also the fungus causing root disease and in addition harmful bacteria which the froghopper was believed to deposit.

Mr. Glasgow was willing to give demonstrations of his method on any estate.

During the next few weeks several planters visited Orange Grove to see his experiments there and two demonstrations were given on other estates, one at Caroni and the other at Cedar Hill.

In view of the interest aroused and of the conflicting statements as to results I visited Orange Grove on November 6, in company with Mr. Moodie and Mr. Cox, and again alone on November 14 and 21. I also visited the treated fields at Caroni, in company with Mr. Glasgow himself on November 21, and the treated fields at Cedar Hill on November 20, with Mr. Fabian, and again on December 13.

METHOD.

The method consisted as reported, of the application of a liquid of secret composition, round the base of the cane plants. The liquid was said to cost about 6 cents per gallon local prices, and possibly 4 cents per gallon wholesale.

Mr. Glasgow also said that as applied to the fields at Orange Grove by the rough and ready method of pouring on the ground from tobacco-tins, one gallon would treat about 20 stools, but that he expected by means of a spraying machine to be able to treat 80 or more stools with one gallon. With 1,750 stools per acre (the number at Orange Grove where all plants are 5 x 5 feet) the amount of liquid required should be 50-100 gallons per acre, costing \$3-\$6.

As regards cost of labour Mr. Glasgow said that six boys could treat about four acres per day, and that on one occasion between 1.30 and 5 p.m. they did a plot of $2\frac{1}{2}$ acres.

The following other particulars were obtained from Mr. Glasgow (1) the liquid would keep in its diluted state for two years; (2) it had no irritating effect on the skin* and gave off no poisonous fumes; (3) 1-1½ oz. of the liquid as applied to the field would kill a man if taken internally.

LABORATORY EXPERIMENTS.

On the 6th November we immersed two nymphs removed from their froth in the liquid as applied to the fields for about two minutes during which time they were prevented from crawling out. After this

* Later Mr. Glasgow stated that the liquid has a slight irritating effect.

immersion they were both actively moving. Two hours afterwards, during which period they had been kept without food in a closed box, one was almost dead and the other sick.

The test was repeated more thoroughly on November 21, when 25 nymphs were kept completely immersed for one minute and then removed and placed on grass roots.

Two hours afterwards 8 were dead, and 17 alive. Of the 17 several were sick, but the majority were active and four had already made fresh coverings of froth.

I tried to arrange for experiments in the power of killing eggs but, owing to a fear of his preparation being analysed, Mr. Glasgow would not allow me to take away trash containing eggs, which had been immersed in his preparation.

FIELD EXPERIMENTS

AT ORANGE GROVE.

On November 6 Mr. Moodie, Mr. Cox and myself were shown fields 12, 13, 14 (Fig. I). The canes were second ratoons of B 6450.

Field 14 had been treated twice with the liquid at the end of August; the eastern half of Field 13 had been treated once

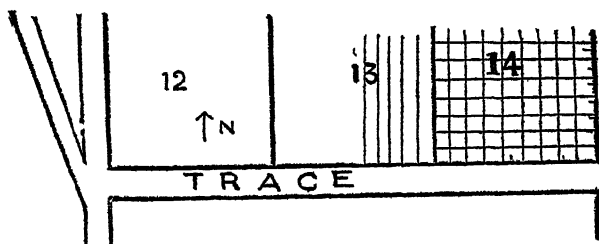


Fig. I.

at the same time; the remainder of Field 13 and Field 12 had not been treated.

It was said that at the time of treatment, Fields 13 and 14 were badly blighted.

At the time of our visit the damage was slight but noticeable. There was, however, nothing to choose between 14 (treated twice) and the treated part of 13 (treated once) or between the treated and untreated plots.

Root disease was occasional on both treated and untreated areas.

Further enquiry elicited the information that the fields had been limed in July and had received a dressing of sulphate of ammonia in September. Some, at least, of the claimed improvement must be credited to this treatment.

On November 14 I visited Field 100 (Fig. II) in which one small section at the S.E. corner had received one application of the liquid. The canes were 1st ratoons of B 156. The northern half of the field had been given a dressing of sheep manure uniformly from one end to the other.

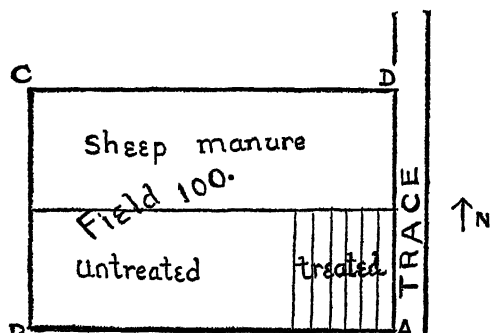


Fig. II.

When examined the canes at the south-eastern corner A (treated) were distinctly better than those at the south-western corner B (untreated) and it was claimed that this was due to the application of the liquid. The change however was gradual and not distinct at the edge of the treatment. In addition the same difference was found along the northern edge of the field where there had been no difference in treatment; the canes at the north-eastern corner D were very much better than at the north-western corner C. In fact the eastern end of the field, treated or untreated, was distinctly better than the western end.

Further, on reference to my notes of last year, I find recorded on November 16, 1917, that a block of damaged fields just to the north of Field 100 (which was then in plant canes) were distinctly better at the eastern end than at the western end, without any difference of treatment.

There is therefore little doubt that the superiority of the treated canes at A over those at B (which were untreated) is in part at least explainable by differences, probably in soil conditions, without any effect on the part of the liquid.

One or two other fields were visited at Orange Grove but in no other case had any part of the fields been left untreated for comparison. Without this no reliable results can be obtained.

Throughout the estate, on fields treated or untreated there were very few froghoppers.

CARONI.

A small block of canes at Caroni, field 77 had been treated on October 26. The canes were 1st ratoons of D 109.

Mr. Glasgow brought 60 gallons of his mixture. This was said to be sufficient for half an acre, but "owing to there being no other land prepared" (the preparation consisted of the removal of the trash from

round the base of the stools) the whole was put on one small patch which I found to contain about 270 stools. This is therefore at the rate of $4\frac{1}{2}$ stools per gallon—or about 550 gallons per acre with 2,500 stools per acre; which at 6 cents per gallon would cost \$33 per acre for material alone for one application.

If one gallon of liquid to 20 or 30 stools is sufficient to reduce the number of froghoppers below the danger limit, an application at this phenomenal rate might be expected to exterminate them completely.

On November 21 Mr. Glasgow and I examined the plots. There was no visible differences between the treated and untreated canes, both of which was slightly but not badly blighted.

We then examined the stools and counted the number of nymphs visible on the surface.

On 120 treated stools at A we found 25 nymphs.

On 120 treated stools at B we found 37 nymphs.

On 120 untreated stools at C we found 45 nymphs.

The application had reduced the number of nymphs from 45 to an average of 31.

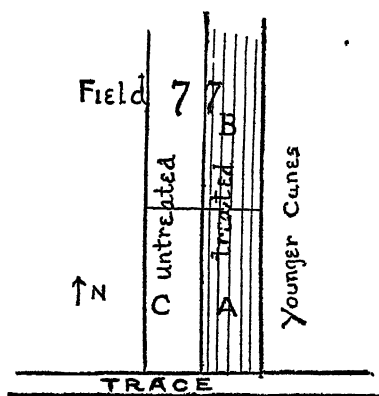


Fig. III.

About 60 per cent. had survived the application.

As many of the survivors were quite young there is no doubt that the application had not destroyed all the eggs.

Root disease was not uncommon on both treated and untreated areas.

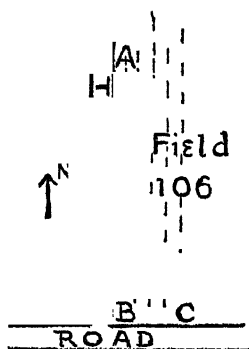
It must be admitted that there were very few froghoppers even on the untreated portions and that, no doubt, if there had been more none would have been destroyed. But the value of the treatment depends largely on whether or not it is applicable before the numbers of the froghoppers have reached the danger limit.

CEDAR HILL.

On November 1 a portion (exact limits not marked) of Field No. 106, 1st ratoons B 156, was treated by Mr. Glasgow with his preparation (exact quantity not recorded).

I was not present at the application but on November 20 the treated cane from A to B (Fig. IV) appeared a little better than the untreated canes just to the north of A, but no difference could be seen between the treated canes between B and C and the untreated canes to the east of this point.

On December 11



I visited the field again and counted the number of nymphs visible on the surface of the ground in the treated and untreated areas.

On 50 treated stools on the bed next to the trace along the western edge of the field I counted 102 nymphs, and on 50 untreated stools about 5 beds to the east I found only 32 nymphs.

Fig. IV.

So that there were actually more nymphs on the treated than on the untreated bed.

It is naturally, not suggested that the treatment was responsible for this, but it shows that variation between different parts of a field must not be hastily credited to special treatments, and further that the mixture in question cannot be said to exterminate either the nymphs or the eggs.

Root disease was present on both treated and untreated plots.

COST OF APPLICATION.

Leaving for a moment the question of the efficacy of the liquid in destroying the frog hopper nymphs or eggs, I made, in collaboration with Mr. Rorer, some experiments to get accurate information on the cost on application of such a method.

Using knapsack sprayers, we found that it was impossible to moisten thoroughly the trash and ground at the base of the cane stools without using at least one gallon of liquid to every 12 stools, or 200 gallons per acre at 2,400 stools per acre.

We further found that the cost of application by this method could not be brought much under \$2 per acre.

So that the complete cost of one treatment of this type would be per acre at least \$2 in addition to the cost of 200 gallons of liquid.

GENERAL CONCLUSIONS.

If a liquid could be found that was thoroughly effective in destroying the frog hopper nymph and eggs in one, or, at the most, two applications, the method is not impossible, provided that the cost of the liquid

itself is not prohibitive; (4 cents per gallon should be the limit unless extermination is complete).

In view of the general shortage of labour however, it is doubtful if the method would be applicable on a very large scale.

The demonstrations so far given by Mr. Glasgow do not prove that his liquid is sufficiently effective in destroying either eggs or nymphs of the froghopper, or the fungi causing root disease. Possibly further demonstrations which he hopes to give next season at a more suitable time of the year may be more conclusive.

December 16, 1918.

COTTON.

NOTES ON THE CULTIVATION OF COTTON.

PREPARATION OF THE SOIL.

For the cultivation of cotton, a fairly light soil is preferable—soils known as “loams” or “sandy loams” are the most suitable. The land should be thoroughly cutlassed or weeded, lined and holes of approximately 18 inches square by 6 inches deep dug. The soil removed from the holes is mixed with 5 lb. (12 to 16 tons per acre) of well rotton pen manure and the holes refilled. When possible the land should either be ploughed or forked and harrowed before lining.

PLANTING SEASON.

There are two distinct periods in the life of the cotton plant: a vegetative period of some 4 to 5 months during which the plant makes its full growth and a reproductive period of some 3 to 4 months during which the bolls are ripening. During the first period a good rainfall is required to ensure a regular growth and the seed should therefore be planted in June or July at latest, at the commencement of the rainy season. The results of experiments carried out at St. Augustine with plantings in June, July, August and September showed a steady decrease in the crops for the later plantings respectively. Three seeds should be put to a hole and $4\frac{1}{2}$ lb. of good seed will be sufficient to plant an acre and supply missing holes. In suitable weather the plants will begin to appear after 5 or 6 days and in order to obtain a regular stand the missing holes should be supplied by the end of the second week.

DRAINING.

If the land requires it, draining should be done immediately before or after planting so that the earth from the drains may be spread at the first weeding. It is a great mistake to believe that because a soil is of a fairly sandy nature it does not require draining. One of the chief causes of the dropping of the flower buds and shedding of bolls is the want of proper drainage.

CULTIVATION.

About four weeks after planting it will be necessary to make the first weeding. This should be done with great care, the grass or weeds close up to the plantlets being removed with the hand so as not to injure the young plants. Such injuries are liable to cause rotting of the stems. The plants should then be slightly moulded up. It is now time to do a preliminary thinning out by pulling out the weakest plant from each hole, care being taken to make the soil firm around the remaining plants. A second weeding will be necessary about 4 to 6 weeks after the first and the young plants should again be moulded up, and the thinning out completed. One and probably two other weedings will be necessary. The last weeding may be done as the bolls begin to open.

PESTS.

The cleaner the cultivation is kept the freer it will be from insects pests. The most serious pest is the cotton stainer which makes its appearance shortly before the bolls begin to open. The best methods of control are trapping and collecting. This is done by tying a handfull of seed-cotton on the plants at some distance apart; the seed attract the stainers which settle in clusters on the traps when they can be shaken off into a tin of water containing a little kerosene oil. If the destruction is carried out systematically the pest can usually be easily kept in check unless very abundant.

REAPING.

Cotton should be picked when the boll is fully opened and its segments perfectly dry. No picking should be done while dew is on the plants or in rainy weather. If the cotton is picked too early the process of ripening is incomplete, the fibres are weak, they do not acquire the twist necessary to give them a good spinning quality and the cotton is difficult to dry. On the other hand cotton that is left too long in the open bolls loses strength, lustre and silkiness and may be so tangled up by the wind that it is difficult to gin.

The pickers should be provided with a canvas bag 18 to 20 inches long and 18 inches wide, made to tie around the waist so that both hands may be free. The bag should have attached in front a pocket about half the size of the bag. Only the good clean cotton is put in the bag, any stained or soiled cotton is put in the pocket. In picking, care should be taken to prevent bits of leaf or any foreign matter from being included with the cotton.

After picking the cotton should be dried by sunning in trays before it is put up for ginning.

The Government Farm undertakes to gin and bale cotton and deliver same in Port-of-Spain at the rate of one cent per lb. of seed cotton.

SEA ISLAND COTTON.

Sea Island cotton is planted 3 feet by 2 feet or 4 feet by 2 feet. the cost of planting and reaping an acre may be estimated at \$60 to \$70 and an average yield of 300 to 400 lb. of seed cotton per acre may be expected. This cotton does not ratoon.

THORNTON'S HYBRID.

This was a hybrid produced by Mr. T. Thornton in Tobago by crossing Sea Island with a "native" cotton. It was grown for some years in Tobago, &c.: but is not in cultivation now. The following figures are however of interest:—

The cost of planting and reaping a three acre field of "Thornton's Hybrid" in 1918, at the St. Augustine Experiment Station was \$68.27 per acre and the cost of cultivating the ratoons the following year was \$44.10 per acre.

This variety was planted 5 feet by 5 feet and the crops reaped were 755 and 485 lb. of seed cotton per acre respectively for the plants and ratoons.

CAUTO COTTON.

In 1916 an experimental plot was planted with seed received from Jamaica. This is a tree cotton and is planted 7 feet by 7 feet. The yield obtained was 1,305 and 735 lb. of seed cotton per acre for the plant and first ratoons respectively. This plot is being carried on as second ratoons and is apparently quite good. The actual cost of cultivation and reaping was \$112.40 per acre for the plants and \$59.70 for the ratoons. This is high owing to the fact that the plot is barely one-fifth of an acre. The results have been sufficiently promising to warrant the trial of this cotton on a larger scale.

SALE PRICES.

The prices of cotton during war conditions have been high, and for the crops grown experimentally in Trinidad and sold in 1918, the following prices were received, Sea Island cotton 8s. 4d. per lb., Cauto cotton 2s. 8d. per lb.

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HORTICULTURE.

BEDDING PLANTS FOR TRINIDAD.⁽¹⁾

By R. O. WILLIAMS,

Acting Supt., Royal Botanic Gardens, and St. Clair Experiment Station.

THIS subject is a very wide one, and I know as individual members we hold different opinions as to whether certain plants should or should not be included in a list of plants suitable for bedding purposes in Trinidad.

Some plants I shall mention would scarcely be termed bedders, but I have included them because bedding plants are somewhat few here, and those mentioned make good flower-garden subjects.

There are many plants which under careful culture and suitable weather conditions can occasionally be grown. Amongst these should be included Double Daisies, Mignonette, Ageratum, Lobelia, Sunflower, Geraniums, Michaelmas Daisies, Hollyhocks and Gladiolus. Where masses of flowers in beds, &c., are required it is no use to rely on these. I have therefore confined myself as far as possible to the best plants which are most suitable to our conditions.

Annuals are a feature of summer bedding in English gardens, but the list of those which thrive here is a very limited one, attributable to several causes. Some of them of course will not thrive at all; others are not grown because of the great difficulty in raising them from seed, or because if raised from seed successfully, insect life is so abundant that many are destroyed.

Although the growth of vegetation is so rapid in the tropics, the laying out of a flower garden and the keeping a constant supply of plants in flower is not such an easy matter as it at first appears, as we have not the well marked seasons of Europe. If here one relies on annuals for a constant supply of flowers, disappointment is sure to be occasionally met for various reasons, such as weather and lack of supply of good seed from abroad. We have however the advantage of possessing many small shrubby flowering plants which can be utilized in the beds in such a manner that never at any time will the whole set of beds be entirely bare of flowers.

I will deal with the plants under four headings: (1) Small shrubs, and perennial bedders. (2) Bulbous and Tuberous rooted plants. (3) Annuals. (4) Plants suitable for edging purposes.

SMALL SHRUBS AND PERENNIALS.

The shrubby and perennial plants will ensure the garden being well stocked with flowers at all times; they are also useful where quantities of cut flowers are required.

Angelonia salicariaefolia is a low shrub with erect spikes of violet coloured flowers. The white variety is also very pretty, and both can be used separately or in combination with good effect. Although this

(1.) A paper read before a meeting of the Horticultural Club.

plant is recorded as being a native, it is not often seen growing wild in Trinidad. It can readily be raised by cuttings, and a large stock can quickly be obtained in this way from a few plants.

Antirrhinums.—These plants, commonly known as Snapdragons, do moderately well in Trinidad during the dry season, but even then they cannot be fully relied upon being somewhat difficult to raise, and after planting out very subject to attacks of mole crickets. I have only been successful in getting one really good bed, although I have made several attempts with good reliable seed. The method practised in England of raising good varieties by cuttings does not seem to answer, as a very small percentage of successes was obtained from several batches inserted.

Begonias.—There are several handsome flowering Begonias well known here, such as *B. coccinea*, President Carnot, *B. dominicalis*, &c. and several with ornamental foliage. All will require a shady position if success is to be assured, as up to the present time only one (*B. coccinea*) has been proved to thrive well in full sunshine and through the dry season without constant watering. This is one of the best of Begonias, and a bed of it should certainly be in every garden, either planted alone or mixed with other subjects such as Plumbago or Tube-rose. Begonias are amongst the easiest of plants to propagate this being done by cuttings and seeds.

The tuberous varieties, so largely used for bedding in England, I have raised from seed and got them to flower in pots, but as bedding plants they were complete failures.

Clerodendron fallax.—One of our best, larger growing, perennial bedders producing quite a wealth of scarlet flowers over a long period. It is only suitable for large beds or borders. Plants are easily raised from seed, and may be cut back several times after flowering when new shoots will develop and flower again profusely.

Coleus.—These are most useful where beds of rich ornamental foliage are desired. They remain in perfection the whole of the wet season, but immediately become shabby at the first signs of drought. Coleus may either be planted as mixed beds or the richer coloured varieties kept distinct. In whichever way they be used, they make a good show. To get bushy plants the tips of the shoots must be pinched out when the plants are young. Young plants can be raised either by cuttings or seeds.

Crossandra undulafolia.—An East Indian plant of from 1 to 3 feet in height. The growth is comparatively slow, and its rich reddish orange spikes of flowers remain in perfection a long time. It has handsome shining green foliage, and the plant is well suited for making neat compact beds of flower.

There is another plant similar in every respect to this but with dull foliage. *Crossandra* may be propagated either by cuttings or by seeds.

Orotone.—These can be used with effect where masses of coloured and variegated foliage are needed.

Cuphea micropetala.—One of the best dwarf shrubs we possess for the flower garden, with small red and yellow flowers which are borne in great profusion. They are rather slow growing in the early stages, taking about two months from seed sowing till they are ready to plant out. When well established pinch out the top of each main shoot to allow them to make bushy growth. They will be in full flower at about five months from the time of planting out, and continue so for about three months when they should be cut back and the beds lightly forked and manured: a second batch of flowers will then soon appear. *Cuphea micropetala* has a great attraction for humming-birds, and as many as half a dozen could be seen at times recently on plants occupying two beds in the Botanic Gardens.

Old plants can be divided when necessary for propagation purposes, but it is best to raise young stock from seed.

Dracœnas.—Good varieties of *Dracœnas* are useful for planting in semi-shady places. In full sunshine the leaves are apt to burn. Propagated from pieces of stems cut into lengths of a few inches and inserted as cuttings.

Galphimia glauca.—Shower of Gold.—A pretty shrub growing to a height of a few feet and commencing to flower when quite young. It is at its best in beds when from 1½ to 2 feet in height, being then covered with quantities of racemes of small yellow flowers. It is in flower for practically the whole year. Propagated by seed.

Hibiscus.—*H. rosa-sinensis* has produced such a wealth of varieties at the hands of hybridists in Trinidad, and other parts of the world, that we have now about 150 varieties of many shades of colour, the majority of which have been raised in the colony,—largely by the Venerable Archdeacon Homborsley.

Hibiscus plants make a very effective sight either massed in large beds or scattered in beds also used for other plants. A few Hibiscus, such as the double varieties, pink and red, can also be grown as standards that is with one straight stem several feet high, and a head of foliage and flowers on the top.

Ixoras.—Some of the smaller growing kinds may be used for large beds, and if planted with a ground work of balsams, tuberoses, or verbenas, they look very pretty. They can be propagated by seeds or by cuttings. A certain amount of pruning will be required to keep them in neat compact bushes when used in beds, this applies more especially to the yellow variety. This one does not come true from seed, and should be increased by division, or by root suckers.

Ixoras are useful as hedge plants in moist districts.

Lagerstrœmia indica.—Crêpe Flower.—There are several varieties, white, pink, red, &c. They grow to a good height and require occasional hard pruning after flowering when used in beds. They also make a good hedge in wet localities. Propagated by cuttings.

Mirabilis Jalapa.—The Marvel of Peru, or Four o'clock, with its various colours of yellow, pink, white, &c., can be used for bedding purposes if desired.

Oleanders.—There are numerous varieties, white, pink, crimson, &c., which are of great use as centre plants for large beds. They are somewhat difficult to propagate. Layering is a good method, also by cuttings.

Pentas carnea a South African soft-wooded shrub grows to a height of 2 to 2½ feet, and makes a handsome flowering perennial for a mixed bed. It does not readily produce seed in Trinidad, but can be propagated by cuttings. For table decorations, (especially by artificial light, it is most attractive.

Plumbago capensis.—One of the most useful plants for the garden, making a good show especially during the dry season. The only care necessary is occasionally to cut out the old shoots, close to the ground, keep the bed well forked and supplied with manure.

Poinciana pulcherrima.—Barbados Pride.—There are two varieties yellow and red; both are well known. They flower at the tip of each shoot which should be cut back after flowering if the plants are intended to be kept small. Propagated by seed.

Poinsettia.—There are three varieties in Trinidad, viz.: the "double" red, the ordinary red and the so-called "white" which is really a pale yellow. The former makes the best show and carries its coloured bracts for a much longer period. Plants of the white can be grown with it to good effect. All are propagated by cuttings, but the double does not root as readily as the other varieties. The white does not come true from seed.

Roses.—Speaking generally hybrid Teas and Teas succeed best although just a few hybrid Perpetuals notably Paul Neyron and Snow Queen do well. A few roses which can usually be relied upon to make a good show in Trinidad gardens are Helen Gould, Etoile de France, Johnker J. L. Mock, Etoile de Lyon, Lady Hillingdon, M^{me}. Constant Soupert, Radiance, Helen Good, the Maman Cochet, President Taft, La Tosca and Marechal Neil.

Russelia juncea.—Antigua heath is a good standby, as it is practically always in flower. It is a pretty sight to watch how this plant attracts humming-birds, some being nearly always seen working at the flowers.

Russelia makes a pretty combination if planted with the variegated *Pedilanthus*. Both thrive in dry situations. Propagated by cuttings or division.

Salvias.—The best known here is probably *Salvia splendens* which makes a very gay show when grown where it gets a little protection from sun. It can readily be propagated by cuttings or slips, a few inches long, inserted in sandy soil.

Salvia coccinea the Scarlet Sage grows about two feet high, and produces quantities of flowers which usually drop off by afternoon leaving the plants bare. Where however one wants morning flowered plants this one is very acceptable. Of much more use for bedding purposes is its white variety, *S. coccinea* var. *alba*, which has not the disadvantage of dropping its flowers in the early part of the

day. They form pretty, well shaped plants, and make quite a show at two months from seed, continuing up to 5 or 6 months old, when they may be cut back, the beds well manured and the plants allowed to shoot again, producing at this second flowering just as good a show of flowers. Once established in the garden, self sown seedlings will be found abundantly.

Scutellaria coccinea.—This plant is one of the best scarlet perennials for general purposes. It grows from a foot to eighteen inches in height and is nearly always in flower. When it begins to get shabby it can be cut hard back, the bed dug and manured, and in a short time is again in full flower. In this way it will occupy a bed for a very long time.

Thunbergia erecta.—There are two varieties, blue and white. They form neat shrubs a few feet in height which flower abundantly. Propagated by cuttings or seeds.

Turnera.—A low growing, bushy shrub, producing an abundance of sulphur coloured flowers violet at the base about 2 in. in diameter. Leaves small about 2 in. by 1 in. and indented. It makes a good display during the morning, the flowers closing before noon. It is readily propagated by division, suckers or seeds.

Vincas—Old Maids or Periwinkles, often serve a useful purpose as edgings or ground work to beds or borders. The white variety can be seen at the Red House Grounds, helping to hide the formal concrete edges to the roads.

Vincas are natives of the West Indies, and for this reason many people are apt to look down upon them and not give them the position in the garden they deserve. They are most useful, hardy plants, rank in point of beauty with many of the more tender exotics, and flower throughout the whole year.

There are three varieties the pink, the white, and the white with a red centre. Propagated either by cuttings or seeds. At Kew the Vincas were found very difficult to propagate and most success was obtained from cuttings in pure sand. They were used there annually as a border to the porch of the water lily house with good effect.

BULBOUS AND TUBEROUS ROOTED PLANTS.

Caladiums are good for planting in beds or garden vases during the wet season. In the dry season they should be taken up and placed in pots. Good tubers of bright coloured varieties should be imported.

Cannas are amongst the best flowering plants, as if properly treated an almost unbroken supply of flowers can be obtained from the same beds for several years. Cut down the old flower stems quite close to the ground immediately after the flowers drop as there are plenty of young shoots coming to take their place.

Cannas are gross feeders and will take liberal supplies of manure with advantage. They may be propagated either by seed or by

division, but the latter method is recommended where plants of the same variety are required. The separate colours such as red, yellow, or pink, massed in beds look very pretty and with attention to the heights of different varieties excellent effects can be obtained with mixed beds.

Occasionally during very wet weather the leaves are attacked with a fungus which somewhat detracts from the appearance of the plants. This can be remedied by spraying with Bordeaux mixture, and keeping the shoots thinned so that air and light can get amongst them.

Dahlias are now coming much into prominence and appear to thrive well under Trinidad conditions.

The best strains are of course from imported tubers, although good varieties can also be raised from seed. I have had good singles flowering recently at six weeks from seed. They deteriorate in this climate after being under cultivation a short time.

Tuberose.—This is a Mexican plant and quite one of our best bulbous plants for bedding out. The single variety is most commonly seen, although a few people have plants of the double. It is most useful in beds which are also planted with permanent shrubby plants such as *Ixoras*, *Hibiscus*, *Begonia coccinea*, &c. The spikes of pure white flowers grow from two to three feet high and are very sweetly scented.

Zephyranthes, are small native bulbous plants of several colours, white, pink, or yellow. They are very abundant, and the pink and white can be used as edgings for beds. Their only drawback is that they only flower for a few days at a time, and the foliage looks somewhat shabby when they are drying down, or when as is frequently the case they become attacked by caterpillars. Whilst in flower however a prettier plant could not be desired. The yellow although it thrives in drains, sides of roads, &c., is very difficult to establish in a garden bed.

ANNUALS.

The list of annuals one can grow with success here is not a long one. I have however dealt with those which from experience have proved to thrive well.

Amaranthus.—*A. caudatus* is the well known Love-lies-bleeding with drooping spikes of reddish purple flowers. The plant grows 2 to 3 feet high and makes a good show in the flower garden. It is especially suited for large beds.

There are several other species of *Amaranthus* which are fine ornamental foliage plants, the heads being of a variety of colours crimson, green, purple, orange, bronze, yellow, and various shades of red. The flowers in these species are inconspicuous, but the foliage makes up for this. A bed in the Botanic Gardens last year could be seen as a bright spot of colour from the opposite side of the Savannah.

Good plants of *Amaranthuses* can be grown from locally raised seed. Mole crickets are troublesome to the young plants.

Asters.—With care and attention Asters will grow well although they do not produce such fine flowers as in English gardens, neither can they be relied upon to make the same massed effect. Propagated by seed.

Balsams.—Our garden balsams are botanically known as *Impatiens*, so named because the seed pods when nearly ripe are impatient of the slightest touch, the valve discharging the seeds at the least provocation.

There are several florists strains but the Camellia flowered balsams are the finest and thrive well. Seeds can be bought in several distinct colours, such as white, cream, rose, salmon-pink, scarlet and violet, and if they be kept apart from each other and seeds selected from the best double flowers, good balsams can be produced for several generations from home grown seed. I have had good double flowers true to type from the fourth generation of seeds grown here from white.

The advantages of balsams are that they make a good show, can be raised and brought into flower quickly; they thus serve a very useful purpose if there is likely to be a bare time in the flower garden. The seeds are easily raised being simply sown in drills out-doors in a sunny place and transferred to the flower beds when a few inches high.

Browallia speciosa major is one of our introductions of last year. Its close relation, *Browallia demissa*, is a common native plant. They are somewhat difficult to raise from seed being very slow in growth but fully compensate one later by the lovely show of blue flowers they are capable of producing. It grows to a height of 18 inches to 2 feet and produces seeds in quantity. The period of growth from sowing of seed to the time it must be discarded from the flower beds is about seven months.

Cockscombs do best in the dry season, as during heavy rains they tend to make very vigorous growth at the expense of good heads of flower. Cockscombs very readily reproduce themselves here by seeds.

Cosmos.—The yellow or orange cosmos is best suited for dry weather conditions, as although making smaller plants during that time they produce more flowers than they do when grown in wet weather. It reproduces itself naturally and can become a regular weed in the garden. The pink and white varieties are much more delicate.

Coreopsis.—These are first rate bedding plants, and make useful flowers for house decorations. They are natives chiefly of the Northern and Central parts of America.

Two species, *C. Drummondii* and *C. tinctoria*, with their numerous colour variations have given us most of the varieties of annual coreopsis used in gardens.

C. tinctoria grows from two to three feet high and produces bright brown and yellow flowers. Seedsmen have produced a variety of strains of different colours from this and also a dwarf one.

C. Drummondii grows from 12 to 18 inches high. The flowers are yellow with a ring of crimson around the disc. This is the most valuable plant and the most attractive for flower beds in Trinidad. It readily reproduces itself by seed, in fact quantities of seedlings can usually be seen growing around the old plants.

Another species *C. grandiflora* also does well with us here and remains in bloom for a long time.

Cuphea miniata is an introduction of 1916 and has proved valuable as a bedder, occupying a bed for nearly eight months during part of the dry and wet season. This is a long period for an annual in Trinidad. It is quite a dwarf plant scarcely reaching a foot in height with scarlet flowers. It readily reproduces itself by seed so there is no fear of losing it.

Dianthus.—A pretty group of garden flowers closely allied to the carnation. They grow from about six inches to one foot in height and have a wide range of colours from white through various shades and markings to blood-red. Great care must be taken in raising the young seedlings. Sow the seeds in boxes of very fine soil and prick off as soon as large enough, later transplant to their permanent position. As an edging to a bed they are very effective, or for small ribbon beds or borders.

Gaillardias make nice compact plants which produce very freely large daisy like flowers of numerous colours, red, yellow, orange, &c. They reproduce themselves readily from seed and unlike many other annuals do not deteriorate when seeded in this country. Seedlings grown up to the fourth generation have been noticed to improve rather than the reverse.

Gomphrena globosa.—Bachelor Buttons are very common but are of great use especially in the wet season for filling vacant beds. They also do well in the dry season. The white and purple varieties are the best to cultivate and they occupy the beds for from three to four months.

Marigolds.—Both African and French Marigolds are good showy plants when grown in the right season. The dry season is the best for the purpose especially for the French variety as during excessive wet weather they tend to make much foliage at the expense of the flower. The African varieties are more suited for the wet season and we have recently had a fine bed of Orange Beauty in the Botanic Gardens. These occupied the beds for four months.

Marigolds are amongst the easiest plants to raise from seed and will be of no difficulty to rear provided sturdy plants be obtained by growing in sunshine. They seed here readily.

Nasturtiums.—I cannot strongly recommend *Nasturtiums* as a good bedder under Trinidad conditions, but occasionally with care one can get a good bed of the Tom Thumb variety, and they are then well worth the trouble bestowed on them. The seeds produced are very few compared with what one obtains in England.

Petunias.—These showy annuals have been derived from *P. nyctaginiflora* an annual, and *P. violacea* a perennial. That they may be grown here with success is amply proved by exhibits at the Club's shows, but they require more care than many of the other annuals mentioned. They are best raised from seed, but can also be raised by cuttings. Mole crickets are very troublesome to the young seedlings in the beds. There are many varieties of *Petunias*, double, single, fringed, &c., but for bedding purposes here the single appears to give the best results.

Phlox Drummondii.—This pretty bedder is a general favourite and an easily grown plant. There are varieties of a wide range of form and colour, all derived from the red-flowered type found in Texas.

They are easily grown from seed and once they become established self sown seedlings will always be found in close proximity to the old plants. *Phlox* are most suitable for small beds or planted between roses where they help to brighten the beds. Many rose growers in England make a regular practice of planting *Phlox Drummondii* in the beds as they take little from the soil and lend a bright splash of colour as a ground-work to the roses.

Tithonia speciosa.—A pretty plant growing to a height of several feet with lovely orange coloured heads of composite flowers. It thrives well in Trinidad, reproduces itself readily by seed, and is very suitable for large round beds.

Torenia asiatica, locally known as Pansies, can be utilised for small beds during the wet season. Seedlings as a rule are very plentiful as the plant appears to have become naturalised.

Verbenas.—Bedding *Verbenas* of hybrid origin are always favourites, owing to the great variety of colours and the easiness with which they can be cultivated. For fancy shaped beds, or as a groundwork to shrubby plants, they are most suitable. Good varieties can be raised from seed, and afterwards propagated by cuttings or layers, as each little shoot where it touches the ground forms roots and can afterwards be severed to form a new plant.

When *Verbenas* become too massed in the beds, they quickly damp off in rainy weather. It is best to renew the beds with young plants or cuttings before they reach this stage. *Verbenas* make the best show during the dry season if well watered.

Zinnias can be reckoned among the best if not the very best annuals for general purposes in Trinidad. They give a brilliant show of colour, are easily raised, flower quickly and very rarely fail. They take two or three weeks from the time of sowing the seeds to the time of transplanting in the beds, are in full flower in from six weeks to two months and over by four months. If double *zinnias* are required it is best to raise them from introduced seeds which have been especially selected by the nurseryman. If one takes any chance seedlings which come up in the beds the majority will usually be singles of inferior value. *Zinnias* are usually grown as mixed colours, as the shades associate so well in a bed that it is not necessary to keep the colours separate unless there is a colour scheme in view. It is a change

however to see occasionally beds of one colour, such as primrose yellow or the red known as Fireball. I tried the white recently but it was far from being a success as the colour was not pure enough. The garden race of Zinnias have all come from *Zinnia elegans* a Mexican plant.

PLANTS SUITABLE FOR EDGING PURPOSES.

Alternanthera.—A good edging plant is the well known *Alternanthera* which can be clipped to form a neat compact border a few inches in height.

Alyssum.—This pretty border plant can be easily raised but grows best during the dry season.

Coleus (Climbing variety).—A small *Coleus* of many colours on a ground work of green, and of scandent habit is very abundant in gardens here. It can be trimmed to form a neat border to a bed.

Myosotis or *Forget-me-nots*.—A very old favourite in the flower garden, but very useful especially during the wet season, for covering bare patches of soil amongst stronger growing plants. Planted in small beds or as edgings, it is very pretty and can be dug up and replanted when it begins to look shabby. It soon dries up in the dry season unless very well watered.

Violets make a very neat edging to beds especially in the wet season and should also be grown for gathering for the house. The leaf growth is so vigorous that the flowers are usually hidden. Propagated by division.

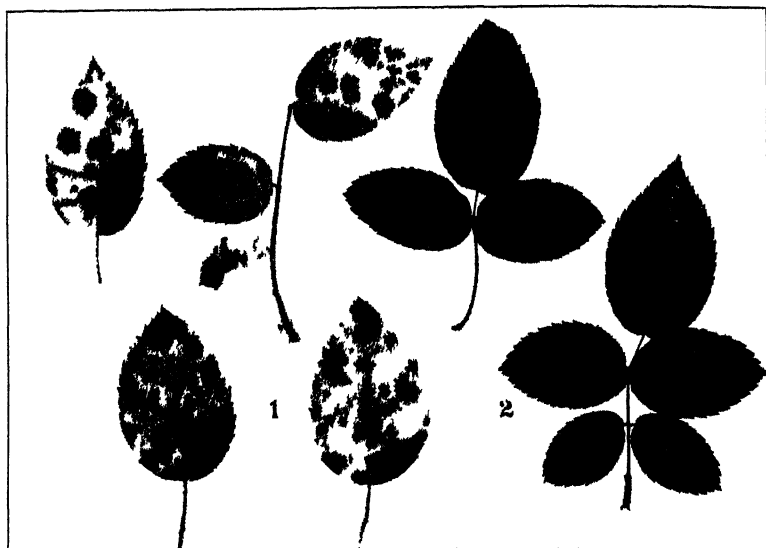
GENERAL.

As a last word I should like to mention that the reason why so many annuals fail here is the difficulty of getting them past the seedling stage. My principal suggestion here and one that I have found to answer well with most seeds is to sow them in boxes and cover till they begin to germinate when they must be immediately transferred to a sunny position, care being taken that they are never allowed to get dry. Seedlings grown in shade become weakly and drawn, and quickly succumb when planted in the open ground.

The plants mentioned in this paper are all suitable for planting throughout the year except those given below which are most suitable for either the dry season (January to May) or the wet season (June to December) respectively.

Plants for the dry season.—*Antirrhinums*, *Amaranthus*, *Cockscomb*, *Cosmos*, *Dianthus*, *Marigolds*, *Nasturtiums*, *Petunias*, *Phlox Drummondii*, *Verbenas*, *Alyssum*.

Plants for the wet season.—*Coleus*, *Mirabilis Jalapa*, *Salvia splendens*, *Browallia speciosa major*, *Torenia*, *Forget-me-nots*.



ROSE LEAF SPOTS



ROSE MILDREW

THE FUNGOUS DISEASES OF ROSES AND THEIR TREATMENT.

By JAMES BIRCH ROBER,
Mycologist, Board of Agriculture.

With One Plate.

ON account of the increased interest in rose growing which has been fostered by the Horticultural Club during the past four or five years, many enquiries have been received by the writer in regard to the treatment of rose diseases. As a result, numerous specimens have been examined in order to ascertain the causes of the diseases, and a series of experiments carried out to find some practical and easy method of combating them.

Though there are several destructive diseases and insect pests of roses in the colony, it must always be remembered that rose plants are very susceptible to unfavourable soil and climatic conditions and their sickly appearance is not always due to diseases or pests.

These plants are rather particular as to soil requirements; good drainage and abundant manure being necessary for successful results. It is fatal, however, to manure rose plants heavily if the ground is not thoroughly drained, as this induces root rots of various kinds. It is essential also that rose gardens be kept free from the roots of other plants, which seem to have a very harmful effect on rose bushes.

There are three fungous diseases of roses which occur wherever these plants are grown, in addition to which there occurs in Trinidad two diseases which have not been reported from other countries so far as the writer knows. All these diseases do a great deal of damage to rose gardens every year, and the black spot, leaf spot and mildew are so common that healthy plants cannot be grown unless some means are taken to combat these troubles.

BLACK SPOT DISEASE.

Perhaps the commonest of all the fungous diseases of roses is the so-called "Black Spot" caused by the fungus *Diplocarpon rosæ*, Wolf, (*Actinonema rosæ*). This disease is characterised by more or less irregularly circular, or oval brown, black spots upon the upper surface of the mature or nearly mature leaves. The spots are quite small at first, but rapidly increase in size during damp weather, several often coalescing, so that one-third or one-half of the leaf surface may be affected. As the spots grow older they become grey in the centre, while the adjacent parts of the leaf turn yellow. See upper figure of plate.

The leaves, even those which are but slightly affected, fall from the plant prematurely, so that sometimes the ground beneath the bushes is covered with fallen leaves. Naturally, the plant immediately puts out new leaves, which under favourable weather conditions, become infected in turn and fall to the ground; thus the bushes become greatly weakened and begin to die back from the tip.

LEAF SPOT.

Another disease, somewhat similar to the Black Spot, is that called "Leaf Spot" caused by the fungus *Cercospora rosaeicola*, Pass. This disease, in appearance, is somewhat like the Black Spot, but can be readily distinguished from it because the spots are circular, and have a distinct dark purplish border. The effect of both diseases on the plants is the same, namely, premature and repeated defoliation which gradually weaken the bushes.

POWDERY MILDEW.

This disease is very common at certain seasons of the year and is very destructive to certain varieties.

The fungus causing the disease is known as *Sphaerotheca panosa*, Lév. The fungus attacks the very young leaves and shoots and covers them with a fine flour-like mildew.

The affected leaves and shoots become dwarfed, curled and deformed, and soon wither up and die. See lower figure of plate.

This disease spreads very rapidly, especially during the time of the year when the nights are cool. Repeated attacks of the disease cause the plants to lose their vitality.

TREATMENT.

All three of the diseases mentioned above yield readily to the same treatment. Experiments have been carried out in which various fungicides have been used, and though several have given good results, the most successful have come from the use of flowers of sulphur mixed with dry arsenate of lead. This is much easier to apply than liquid fungicides, as it is simply dusted on the plants, and does not discolour the foliage and flowers to the same extent.

The flowers of sulphur should be very fine, so that it will pass through a 200 mesh to the inch sieve, and dry arsenate of lead should be added at the rate of one pound to every nine of sulphur, and thoroughly mixed in.⁽¹⁾ It is necessary to make several applications of this mixture to the plants, especially at the beginning of the rainy season, *before* the plants become badly infected. It must always be borne in mind that plant diseases really cannot be cured but only prevented. The numbers of dustings necessary for a season cannot be definitely laid down, but is dependent altogether on weather conditions. At the beginning of the season however, it is advisable to make three or four applications at intervals of from seven to ten days. Later in the season the interval between the dustings can be lengthened according to judgment.

During the past season, several experiments have been carried out with the sulphur arsenate mixture, as a control for the leaf spots and mildew, and at the time of writing the treated plants are practically free from fungous diseases, and in very healthy condition, while the untreated plants are badly affected, or even leafless.

(1.) Sulphur and arsenate of lead can be purchased locally, but the prices are very high, which makes the treatment rather costly. The Board of Agriculture has, however, ordered a mixture made by the Union Sulphur Company, which will be sold at a reasonable rate. The Board also has on hand a limited number of Juxta clusters, which can be used for applying the mixture.

RED RUST.

The Red Rust of roses is caused by the parasitic alga *Cephaleuros virescens* which attacks a wide variety of plants in the tropics. This disease is met with on roses only in fairly damp situations, but in such places does an immense amount of damage, killing the plants right down to the ground.

The disease begins as a very small black or purplish spot on the stem, which increases very rapidly in size until eventually the whole stem, from top to bottom, becomes almost black and the bark cracks slightly. Very soon, owing to the development of the fruiting stalks of the alga, the affected parts assume a reddish velvety appearance, and when examined under a hand lens of low power, it will be seen that they are covered with minute red stalks standing very close together, and each surmounted by a little round red ball. Though this alga does not penetrate very deep into the bark, it kills the outer layers very quickly.

TREATMENT.

Where plants are badly affected with this disease, the only thing to do is to cut them back very severely and, as they make new growth, spray continually with Bordeaux mixture. In damp situations, perhaps fifteen or twenty applications a year would be necessary to protect the plants from this trouble.

The alga causing this disease must not be confused with the so-called "Red-headed" fungus, which attacks scale insects, and which is very often found on rose plants in damp situations. The Red-headed fungus is much brighter in colour than the alga and does not cover the whole plant, but if examined closely, it will be seen that it is growing out from scale insects.

This is a beneficial fungus, as it kills the scale insects, but can only develop abundantly in damp situations, and would be considered on the whole a successful control for rose scales.

ROSE CANKER.

Another fungus disease of roses, which has been found occasionally, may be called "Rose Canker."

This disease is caused by a species of *Stilbum*. Small purplish spots appear on the rose stems which gradually increase in size, sometimes even girdling the branch. The bark becomes shrivelled and sunken, and in the later stages is covered with bright red stalks, surmounted by red globules. This disease can be controlled by cutting out and burning the diseased stems.

If one watches the rose plants carefully, it will be seen that certain varieties or individual plants are immune or partially immune to some of the fungous diseases. An effort should always be made to select resistant varieties and propagate from resistant plants, wherever possible.

AGRICULTURAL CREDIT SOCIETIES.

Registration of New Societies.

CHARLOTTEVILLE (TOBAGO).

(From the *Trinidad Royal Gazette*, Vol. 88. p. 134.)

REGISTERED No. 7.—I hereby certify that application for the Registration of the Charlotteville (Tobago) Agricultural Credit Society, whose office or place of business is Charlotteville, Tobago, has been made by Mr. Richard Benjamin Alleyne, Secretary, and that the above Society has been duly registered under the Agricultural Credit Societies Ordinance, No. 30 of 1915.

W. G. FREEMAN,

February 4, 1919.

Registrar (Acting).

LOTHIANS.

(From the *Trinidad Royal Gazette*, Vol. 88. p. 322).

REGISTERED No. 8.—I hereby certify that application for the Registration of the Lothians Agricultural Credit Society, whose office or place of business is Usine Ste. Madeleine, San Fernando, has been made by Mr. Gilbert Chauncey Skinner, Secretary, and that the above Society has been duly registered under the Agricultural Credit Societies Ordinance, No. 30 of 1915.

W. G. FREEMAN,

April 4, 1919.

Registrar (Acting).

MALGRETOUT.

(From the *Trinidad Royal Gazette*, Vol. 88. p. 366).

REGISTERED No. 9.—I hereby certify that application for the Registration of the Malgretout Agricultural Credit Society, whose office or place of business is Usine Ste. Madeleine, San Fernando, has been made by Mr. Gilbert Chauncey Skinner, Secretary, and that the above Society has been duly registered under the Agricultural Credit Societies Ordinance, No. 30 of 1915.

W. G. FREEMAN,

April 30, 1919.

Registrar (Acting).

PETIT MORNE.

(From the *Trinidad Royal Gazette*, Vol. 88. p. 366).

REGISTERED No. 10.—I hereby certify that application for the Registration of the Petit Morne Agricultural Credit Society, whose office or place of business is Usine Ste. Madeleine, San Fernando, has been made by Mr. Gilbert Chauncey Skinner, Secretary, and that the above Society has been duly registered under the Agricultural Credit Societies Ordinance, No. 30 of 1915.

W. G. FREEMAN,

April 30, 1919.

Registrar (Acting).

UNION HALL.

(From the *Trinidad Royal Gazette*, Vol. 88. p. 366).

REGISTERED No. 11.—I hereby certify that application for the Registration of the Union Hall Agricultural Credit Society, whose office or place of business is Usine Ste. Madeleine, San Fernando, has been made by Mr. Gilbert Chauncey Skinner, Secretary, and that the above Society has been duly registered under the Agricultural Credit Societies Ordinance, No. 80 of 1915.

W. G. FREEMAN,
Registrar (Acting).

April 80. 1919.

Inspector of Agricultural Credit Societies.

(From the *Trinidad Royal Gazette*, Vol. 88. p. 226.)

Under the authority of Section 2, Sub-section (2) of the Agricultural Credit Societies Ordinance, 1915 I hereby appoint Mr. Jos. E. SEHEULT, Chief Clerk, Department of Agriculture, to be Inspector of Agricultural Credit Societies registered under the above Ordinance.

W. G. FREEMAN,
Registrar (Acting).

March 8, 1919.

Mr. Seheult spent from April 22 to May 2 in Tobago, visited the six Credit Societies at work there, inspected their books, gave instruction and assistance in the keeping of their accounts, and addressed a meeting of the members of each Society.

AGRICULTURAL EDUCATION.

CANE FARMERS' PRIZE COMPETITION, 1918.

Report of the Judges.

THE PRESIDENT, BOARD OF AGRICULTURE.

YOUR EXCELLENCY,

We have the honour to report that, commencing on the morning December 17, 1918 we completed our judging of the above-named Competition on the afternoon of the 21st.

Forty-five Competitors were presented for examination; nineteen in the Northern or No. 1 District, and twenty-six in the Southern or No. 2 District. ⁽¹⁾

The work of every farm was carefully inspected and its advantages of soil and situation noted. All the farmers were present during the inspection of their respective farms, and each was rigidly examined to test the soundness of his practice and also his grasp of the broad principles that underlie the various operations incidental to Cane cultivation.

On the whole the answers and demonstrations were very satisfactory; it is quite evident that the majority of competitors have received a considerable measure of true education during their six-months course of preparation for the contest.

As compared with neighbouring farms of non-competitors the farms of the competitors everywhere evinced decided superiority; and, as evidence of the benefit of good cultivation, must tend to general improvement in the methods of the surrounding districts.

Some interesting "points" have been gleaned during the course of the judging. The most worthy of note is the distinct popularity of the strain of sugar cane known commonly as "Burks" (B. 347). This cane has been given universally the reputation of a prolific "ratooner"; and, as farmers depend on their ratoon crops to make their profits, B. 347 is their idol. The next in popularity is B. 156, which has a string of local names, e.g. "Seedlings" "White or Little Roseau," "Esperanza." This is one of the few strains of prickle-less canes.

Of the forty-five competitors, the work of thirteen—eight in No. 1 district and five in No. 2 district—was "*prima facie*" below a three-fifths standard.

In making the awards the judges have aimed throughout at gauging as accurately as possible the amount of effort and industry correctly applied by each competitor to his work. We have not been unduly influenced, therefore, by the "crop" appearance which largely depends on natural soil-condition not to be appreciably modified in the space of six months.

(1) For the rules of the Competition and the boundaries of the district See *Bulletin* XVII 1918 page 49 (Ed.).

With respect to the system of "marking" it was found expedient to amplify the outline given in Rule 6 and divide the 80 marks allowed for "Tillage" into "Tillage Proper" 60 marks and "Cultivation or Up Keep" 20 marks. It was also thought just and advisable, bearing in mind the aims of these Competitions, to allow under the head of "General" a small number of marks, viz: 4, for theoretical knowledge without a due proportion of which no industry can ever be progressive. As the results showed that over 80 per cent. of the competitors had some grounding in this subject and 75 per cent. of these had put their knowledge into practice also, the indications of the possibility of a future healthy Cane farming industry are indeed hopeful.

We unhesitatingly pronounce the Competition as a whole a success. The competitors have generally proved themselves intelligent and persevering workers, actuated by a healthy spirit of rivalry and we regret only that there are not more prizes within our power to recommend.

When the individual results of the two districts are compared it will be noticed that competitors in the No. 2 district have been keener than in the other. In that District only 9 marks separate the 88 of the 6th place from 92 of the first, while even the 21st on the list was but 32 marks below the prize winner. The champion of the whole Competition, however, is in the No. 1 District.

Special mention must be made of the following:—

Samuel Taylor (98 marks) who has won the first place in No. 1 District and secured the highest number of marks in the combined results may be termed a model Cane-farmer. He is an active member of the Savana Grande District Agricultural Society and possessed of some "book-learning." Yet, with his own hands he has done most of the work of his farm and reared a fine-looking crop of canes on a stiff slope that was quite recently under para grass and "black-sage" and bore a bad reputation.

Hosein Baksh (82 marks) the winner of second place in No. 1 District also deserves praise for his courageous effort with a piece of land very similar to Taylor's. Having no book-learning and little practical experience this competitor had relied solely on the instruction of the Adviser and deserves approbation for his creditable attempt, in spite of sceptical neighbours and compatriots, to carry out those instructions.

Jama (81 marks) also deserves praise particularly when her sex is taken into consideration.

Simon Fortune (92 marks) the winner of the first place in No. 2 District had the advantage of better soil and situation than the foregoing but fully deserves his success. His cane garden is evidently kept as a "garden" indeed.

The names of a few others that have earned distinction for marked superiority in some branch or other of the work appear in the complete list of "Distinctions" below

In exercise of the privilege granted under Rule 8 the judges beg to suggest that the prizes be awarded as follows :

To the Northern or No. 1 District a first prize of fifty dollars as advertised ; second prize twenty-eight dollars instead of thirty-five, and third prize seventeen dollars instead of twenty. As there is a tie for the fourth place we suggest that the ten dollars offered as fourth prize be equally divided between the two competitors.

To the Southern or No. 2 District—a first prize of fifty dollars as advertised ; also the second prize of thirty-five dollars ; and as four competitors are grouped together for the third place we suggest that the remaining forty dollars of the prize money be shared equally by them. These suggestions have been embodied in the table of results.

In conclusion we beg to state that we have executed our commission methodically and given careful thought to our suggestions and remarks and hope they meet with your Excellency's and the Board's approval.

We have, etc.

(Sgd.) E. S. SWAN.

December 30, 1918.

C M. ROACH.

LIST OF DISTINCTIONS.

Names.	Number of District.	Tillage percentage of marks.	Cultivation percentage of marks.	Theory, Etc. percentage of marks.
Samuel Taylor ...	1	100 per cent.	95 per cent...	95 per cent.
Simon Fortune ...	2	95 „	95 „	
Katiwarroo ...	1	95 „		
Jama ...	1	95 „		
Paul Gobin ...	1	95 „		
I. Bridgelalsingh ...	1	...	...	95 per cent.

LIST OF PRIZE WINNERS.

No. 1 DISTRICT.

Place.	Name of Competitor.	Locality.	Prize.	Marks.	Amount.
1	Samuel Taylor	... Garth ...	1st	98	\$50
2	Hosein Baksh	... Gasparillo ...	2nd	82	28
3	Jama ...	... „ ...	3rd	81	17
4	Ramsehai ...	... Craignish ...	4th	80	5
5	J. Dookie ...	... Gasparillo ...	5th	80	5

No. 2 DISTRICT.

1	Simon Fortune	.. Princes Town ...	1st	92	\$50
2	N. Farrell ...	.. Lothians ..	2nd	87	35
3	Katwarroo ...	... Palmiste ...	3rd	83	10
4	Paul Gobin ...	... Bronte ...	4th	83	10
5	Edward Phillips	... Lothians ..	5th	83	10
6	Henry Benjamin	... Malgretoute ...	6th	83	10

CANE FARMERS PRIZE COMPETITION 1919.

THE Board of Agriculture has instituted a competition this year in the Tacarigua-Caroni and Couva-Chaguanas Districts, under the charge of Agricultural Adviser, Mr. C. McD. Roach. The rules are the same as those for the 1918 Competition (*Bulletin, Department of Agriculture*, XVII. 1918, 49).

The Competition will be confined to two Districts.

No. 1.—TACARIGUA-CARONI bounded as follows:—

North—Line 2 miles north of and parallel to Eastern Main Road.

South—Chaguanas-Caparo Road.

East—Line crossing Chin-Chin Road by 2 mile post Mausica and Lopinot Roads.

West—Maracas, Curepe and Caroni Savannah Roads.

No. 2.—COUVA-CHAGUANAS bounded as follows:—

North—Chaguanas-Caparo Road.

South—Hermitage Road.

East—Line from Hermitage-Caratal junction to Longdenville crossing Couva Main by 5 miles.

West—The Sea.

The following Prizes will be given in each District:—

	1st	2nd	3rd	4th Prizes.
DISTRICT (1) Tacarigua-Caroni	...\$50	\$35	\$20	\$10
„ (2) Couva-Chaguanas	...\$50	\$35	\$20	\$10

TRINIDAD CACAO PRIZE COMPETITION, 1919-20.

Poole and Rio Claro Districts.

THE Board offers prizes to the value of 440 dollars for the encouragement of good cultivation of Cacao by Peasant Proprietors and Contractors.

RULES.

(1.) Prizes will be awarded for good cultivation of cacao.

(2.) Prizes will be awarded in two classes.

Class I.—For Peasant Proprietors with not more than 16 acres in cacao cultivation in one piece.

Class II.—For Contractors.

(3.) No Peasant Proprietor will be allowed to compete in Class I who has less than 5 acres of bearing cacao, no Contractor will be allowed to compete in Class II who has less than 2½ acres in trees 3 years old at the time of entry.

(4.) No person can compete in more than one class.

(5.) Prizes may not be given unless there are at least 50 Competitors in each of the classes.

(6.) The prizes offered are as follows:—

	1st	2nd	3rd	4th	5th	6th	7th
Class I.—Peasant Proprietors	\$80	\$60	\$40	\$30	\$20	\$15	\$10
Class II.—Contractors	... \$60	\$45	\$30	\$20	\$15	\$10	\$ 5

(7.) The Competition will be confined to the Poole and Rio Claro District, bounded as follows:—

North by a line drawn across the Cunapo Southern Road at the 16th mile.

South by the Ortoire River.

East by a line across the Naparima-Mayaro Road at the 32nd mile.

West by the Poole River.

(8.) The Competition will be for the period May 1, 1919 to March 31, 1920.

Due notice will be given before the judging commences.

(9.) In judging marks will be given under the following heads:—

(1.) General Cultivation and Tillage 50 points.

(2.) Sanitation and Treatment of Disease 30 „

(3.) General, including Crop Records, live stock and any special features 20 „

(10.) The Board of Agriculture, on the recommendation of the judges, may withhold or alter the value of any or of all the prizes if cultivations entered for competition are not considered of sufficient merit.

(11.) Applications for rules and entry forms should be made to the Agricultural Adviser, at Rio Claro or at the office of the Department of Agriculture, Experiment Station, St. Clair, Port-of-Spain.

Entry to Competition Free.

Entries may be sent post free if addressed to:—

The Agricultural Adviser, Rio Claro, or

The Director of Agriculture, Experiment Station, St. Clair, Port-of-Spain.

Mr. L. Mota, the Board's Adviser will visit all holdings entered for competition and give advice as to the best methods of cultivation, free of charge.

TOBAGO CACAO AND VEGETABLE PRIZE COMPETITIONS, 1919-20.

THE Board offers prizes to the value of \$248.00 for the encouragement of good cultivation of Cacao and Vegetables by Peasant Proprietors and Contractors.

Cacao Prize Competition.

RULES.

(1.) Prizes will be awarded for good cultivation of Cacao.

(2.) Prizes will be awarded in three classes :—

CLASS I.—For Prize Winners in 1917.

1st Prize	...	...	...	\$ 25.00
2nd Prize	...	...	...	15.00

CLASS II.—For Peasant Proprietors who did not win a prize in 1917.

1st Prize	..	...	..	\$ 25.00
2nd Prize	...	...	..	20.00
3rd Prize	...	...	...	15.00
4th Prize	..	...	...	10.00
5th Prize	...	...	...	5.00

CLASS III.—For Contractors.

1st Prize	...	...	..	\$ 20.00
2nd Prize	..	...	—	15.00
3rd Prize	..	...	...	10.00
4th Prize	...	...	...	5.00
5th Prize	...	...	...	3.00

(3.) No person can compete in more than one class.

(4.) Previous prize winners can only compete in Class I.

(5.) No prizes will be awarded in Class I, unless three-fourths of the 1917 prize winners compete.

(6.) No Peasant Proprietor will be allowed to compete in Class II unless he or she has not less than 3 acres of land of which 2 acres must be in bearing Cacao.

(7.) No prize will be awarded in Class II unless there are 50 entries.

(8.) No prizes will be awarded in Class III unless there are at least 25 entries.

(9.) No Contractor will be allowed to compete, whose contract is less than three acres, with less than 1 acre in bearing cacao.

(10.) The Competition will be for the period April, 1919 to May, 1920.

(11.) Marks will be given under the following heads :—

Cultivation	...	...	...	...	50
Sanitation	...	...	...	...	30
General	...	..	..	...	20

(12.) In judging, the method of cultivation, condition of the trees, the circumstances of each cultivation, the characteristics of the locality, and implements used, together with the condition of live stock, young cultivation and manure heap, if any, will be taken into consideration. Competitors should also be able to answer any simple agricultural questions which may be asked on their work.

(13.) Due notice will be given before the judging commences in March, 1920, and the decision of the Board will in all cases be final.

Vegetable Prize Competition.

(1.) Prizes will be awarded in the following classes :—

CLASS I.

$\frac{1}{2}$ acre of potatoes, with corn and blackeye, or pigeon peas or

$\frac{1}{4}$ acre of yams, with corn and blackeye or red peas.

1st Prize	...	..	...	...	\$ 15.00
2nd Prize	..	...	...	...	10.00
3rd Prize	..	...	...	...	5.00

CLASS II.

$\frac{1}{2}$ acre of plantains with tannias or cassava and corn or blackeye peas.

1st Prize	..	...	...	..	\$ 15.00
2nd Prize	...	...	...	...	10.00
3rd Prize	..	...	...	...	5.00

CLASS III.

$\frac{1}{4}$ acre of Rice.

1st Prize	..	...	...	...	\$ 10.00
2nd Prize	..	...	...	...	6.00
3rd Prize	...	...	...	...	4.00

(2.) The Vegetable competition will be for period of May to September, 1919.

(3.) No prizes will be awarded unless there are 25 competitors in Classes I and II and 10 competitors in Class III.

(4.) In judging, the methods of cultivation and condition of plants together with the circumstances of each cultivation, the characteristics of the locality, implements used, and the ability of competitors to answer agricultural questions relating to their work, will be taken into consideration by the judges.

(5.) Due notice will be given before the judging takes place in September, 1919.

(6.) A competitor may enter one or all of these classes.

GENERAL.

Entry to the Competitions Free.

Entry Forms may be obtained on application to

Agricultural Adviser, Scarborough, the Botanic Station, Wardens' Offices, or the Secretary of any Agricultural Credit Society.

Entry Forms if addressed to

The Agricultural Adviser,

Scarboro,

may be sent post free.

All entries must be sent in on or before May 31, 1919.

The Agricultural Adviser will visit all holdings entered for competition and give advice as to the best methods of cultivation **free of any charge.**

The Agricultural Adviser will select the best competitors in each class to be visited by the judges.

The Board may on the report of the judges, withhold or alter the value of any or all of the prizes if the cultivations entered for competition are not considered of sufficient merit.

AREA OF TRINIDAD AND TOBAGO.

THE following information by Mr. E. R. Smart, M.A., Engineer in Charge of Surveys, as to the area of the Counties, Wards and Boroughs of Trinidad and Tobago, has been published in Council Paper No. 17 of 1919. The Counties and Wards are those as defined by Ordinance No. 1 of 1918 :—

Trinidad.

County.	Ward.	Acres.	Square Miles.
St. George...	Diego Martin ..	33,762	52.75
	St. Ann's ...	30,305	47.35
	Blanchisense ...	48,532	75.33
	Tacarigua ..	46,954	73.37
	Arima ...	42,598	65.00
		201,148	314.30
St. David ...	Toco ...	50,254	78.52
Caroni ...	Cunupia ...	29,413	45.96
	Chaguanas ..	48,783	76.22
	San Rafael ..	24,535	38.34
	Montserrat ...	37,376	58.40
	Couva ...	22,060	34.47
		162,167	253.39
St. Andrew	Valencia ...	30,597	47.81
	Matura ...	38,273	59.80
	Manzanilla ..	46,057	71.96
	Turure ..	44,228	69.11
	Tamana ...	24,141	37.72
		183,296	286.40
Victoria ...	Pointe-à-Pierre ...	20,446	31.95
	Naparima ...	35,092	54.83
	Savana Grande ..	31,924	49.88
	Ortoire ...	54,809	85.64
	Moruga ...	58,325	91.13
		200,596	313.43
Nariva ...	Charuma ...	54,528	85.20
	Cocal ...	73,318	114.56
		127,846	199.76
St. Patrick	Cedros ...	36,300	56.72
	La Brea ...	36,659	57.28
	Erin ...	27,440	42.87
	Siparia ...	66,431	103.80
		166,830	260.67
Mayaro ...	Guayaguayare ...	51,007	79.79
	Trinity ...	45,483	71.67
		96,490	150.77
	Tobago ...	73,213	114.40

Areas of Counties and Boroughs.

				Acres.	Square Miles.
1.	St. George	...	..	201,148	314·30
2.	St. David	..	...	50,254	78·52
3.	Caroni	...	..	162,167	253·39
4.	St. Andrew	...	..	183,296	286·40
5.	Victoria	..	...	200,596	313·43
6.	Nariva	...	...	127,846	199·76
7.	St. Patrick	...	..	166,830	260·67
8.	Mayaro	..	...	96,490	150·77
9.	Borough of Port-of-Spain	...	...	1,793	2·80
10.	Borough of San Fernando	...	..	670	1·05
11.	Borough of Arima	...	..	588	0·91
	Trinidad	...	..	1,191,678	1,862·00
	Tobago	..	...	73,213	114·40
	Total Trinidad and Tobago	...	..	1,264,891	1,976·40

METEOROLOGY.

RAINFALL RETURN- JANUARY TO MARCH, 1919.

Stations.	January.	February.	March.	Total.	Total corresponding period '18.
<i>North-west District.</i>					
St. Clair—Royal Botanic Gardens ...	.. '62	nil	1'78	2'40	5'81
Port-of-Spain—Colonial Hospital ...	.. '05	nil	2'14	2'19	5'12
.. Royal Gaol... ..	.. '50	'06	2'24	2'80	9'83
.. Constabulary Headquarters ...	.. '28	'06	1'87	2'21	5'77
St. Ann's—Reservoir ...	.. '37	nil	2'16	2'53	10'77
Maraval— ..	.. '75	'04	1'39	2'38	8'44
.. Constabulary Station ...	.. '60	nil	2'63	3'23	7'02
Diego Martin—Constabulary Station ...	.. 1'04	nil	3'72	4'76	7'63
.. Waterworks ...	.. '69	nil	2'97	3'66	6'42
.. River estate ...	.. '48	nil	2'72	3'20	6'80
Fort George Signal Station ...	.. '76	nil	2'10	2'82	5'16
North Post ..	.. '23	nil	2'81	3'04	7'07
Carenage Constabulary Station ...	.. '79	nil	4'07	4'86	6'52
Carrera Island Convict Depot ...	.. '24	nil	1'03	1'27	2'56
Chacachacare Lighthouse ...	.. '51	'02	1'70	2'23	7'10
<i>Santa Cruz—Maracas District.</i>					
Santa Cruz—Constabulary Station ...	.. '47	nil	4'28	4'75	9'26
St. Joseph—Government Farm ...	.. '87	'10	1'11	2'08	5'53
.. Constabulary Station ...	.. '18	nil	0'91	1'09	3'21
Tunapuna—St. Augustine estate ...	.. '57	nil	1'11	1'68	4'17
Maracas—Government School ...	.. '29	'05	3'10	3'44	11'29
.. Ortinola estate ..	.. '62	'11	2'66	3'39	7'78
.. San José estate ...	.. '74	'17	1'83	2'74	6'81
Caura—Wardour estate ...	.. '60	'09	1'65	2'35	6'05
<i>West Central District.</i>					
Caroni—Frederick estate ...	.. 3'15	'57	1'39	5'11	5'54
Chaguanas—Constabulary Station ...	.. '82	'12	1'34	2'28	5'66
.. Woodford Lodge estate ...	.. 1'03	'14	1'41	2'58	5'66
Carapichaima—Waterloo estate ...	.. '62	'21	1'32	2'15	6'50
.. McBean Cacao estate ...	.. '92	'43	1'69	3'04	5'35
.. Friendship Hall estate... ..	.. 1'22	'38	1'37	2'97	...
Couva—Exchange estate ...	.. '73	nil	2'02	2'75	3'86
.. Brechin Castle estate ...	.. 1'01	nil	3'13	4'14	5'52
.. Perseverance ..	.. ...	...	...	...	4'60
.. Camden ..	.. '62	nil	1'97	2'59	...
.. Milton ..	.. '35	'38	1'57	2'30	6'73
.. Spring ..	.. '65	'05	2'82	3'52	8'63
.. Constabulary Station ...	.. '57	nil	2'60	3'17	4'83
.. Esperanza estate ...	.. '25	'48	2'30	3'53	4'95
<i>Montserrat District.</i>					
Brasso-Piedra—Mamoral estate ...	.. 1'45	'33	1'92	3'70	13'31
.. La Mariana estate ...	.. 1'45	'13	1'95	3'53	11'29
Montserrat—Constabulary Station ...	.. 2'62	'62	1'11	4'35	8'34
Brasso—La Vega estate ...	.. 1'38	'46	1'39	3'23	11'02
<i>Arima District.</i>					
Arima—Warden's Office ...	.. '85	nil	0'91	1'76	6'39
.. Torrecilla estate ...	.. 1'26	'08	1'10	2'44	9'91
.. Verdant Vale estate ...	.. 1'70	'76	1'66	4'12	7'70
San Rafael—Constabulary Station ...	.. 2'45	'19	2'15	4'79	13'74
Guanapo—Talparo estate ...	.. 2'25	'23	2'95	5'43	10'05
.. El Quemado Estate ...	.. 2'17	'35	2'67	5'19	13'35
Tamana—Sta. Marta estate ...	.. 2'73	'49	2'77	5'99	16'83
.. La Carona estate ...	.. 2'58	'46	3'29	6'33	14'33
<i>San Fernando & Princes Town District.</i>					
Claxton's Bay—Forres Park estate ...	.. '38	'40	1'12	1'90	6'93
Pointe-à-Pierre—Bonne Aventure estate ...	.. ...	...	...	...	6'15
.. Concord estate ..	.. '27	'02	'85	1'14	7'04
.. Plein Palais estate ..	.. '39	'06	1'62	2'57	5'87
Napierima—Picton estate ...	.. '71	'13	2'24	3'08	9'99
.. Usine St. Madeleine estate ...	.. '86	'08	2'63	3'62	10'58
.. La Fortunée estate ...	.. '78	nil	1'35	2'43	7'07
.. Tarouba estate ...	.. 1'77	nil	1'64	3'41	6'46
.. Union Hall estate ...	.. '82	'06	'79	1'67	5'38

RAINFALL RETURN—JAN. TO MAR., 1919.—CONTD.

Stations.	January.	February.	March.	Total.	Total corresponding period '18.
<i>San Fernando and Princes Town District.—(Contd.)</i>					
Naparima—Palmiste estate	1.36	.19	2.24	3.79	8.89
„ Lewisville House	2.29	.08	2.57	4.94	9.84
„ Hermitage estate ... ..	.69	nil	1.78	2.47	8.31
„ Petit Morne estate	1.05	.05	2.30	3.40	7.55
Princes Town—Craignish estate ... ..	.90	.24	2.22	3.45	11.39
„ Cedar Hill estate ... ..	.80	.50	2.21	3.60	9.06
„ Williamsville estate	1.57	.50	1.90	3.97	7.02
„ Esmeralda estate	1.69	.69	1.38	3.76	...
„ New Grant estate	1.00	.38	2.39	3.77	14.05
„ Constabulary Station ... ..	.67	1.12	1.17	2.96	9.93
„ Hindustan estate ... ..	.98	.28	2.40	3.66	10.25
„ La Retraite estate	1.91	.58	3.00	5.49	15.53
„ Malgretoute estate	1.21	1.23	.24	2.68	11.09
Friendship & Ben Lomond estates ... ..	...	...	...	...	10.75
Los Naranjos estate ... ..	.91	1.14	2.33	4.38	10.93
Poole—El Rosario estate	1.53	.33	2.33	3.99	15.23
<i>South-west District.</i>					
Oropuche—Constabulary Station	1.16	.04	1.33	2.53	9.77
„ Pluck estate	1.31	.53	2.28	4.12	9.44
Siparia—Constabulary Station ... ..	.76	.77	.05	2.48	9.94
„ Alta Gracia estate	1.44	.94	2.08	4.46	10.11
Guapo—Adventure estate ... ..	.77	nil	1.96	2.73	7.34
Point Fortin—Constabulary Station	1.20	nil	2.07	3.27	8.53
Erin—La Ressource estate	nil	.05	.89	.94	...
La Re-union estate ... ..	.41	.38	1.04	1.83	9.77
Industry estate ... ..	.69	.11	1.38	2.18	10.37
Cedros—La Retraite estate ... ..	.99	.11	2.88	3.98	14.23
„ Beaulieu estate ... ..	.65	.13	1.45	2.23	12.04
„ Perseverance estate	nil	nil	2.65	2.65	14.41
„ St. Marie estate ... ..	.68	.09	2.65	3.42	13.10
„ Constabulary Station ... ..	.54	.11	3.35	4.00	13.29
„ St. Quintin estate ... ..	.50	nil	1.77	2.27	15.28
Ioacos—Constance estate	nil	nil	1.00	1.00	35.48
Irois—Government School ... ..	.37	.88	3.02	4.27	11.44
<i>South Coast.</i>					
Moruga—Constabulary Station ... ..	.81	.41	1.75	2.97	9.96
<i>East Coast.</i>					
Matura—La Juanita estate	1.72	.35	2.52	4.60	16.72
Mauzanilla—Constabulary Station	2.52	.13	2.48	5.13	15.53
„ Indrasan estate	2.44	...	2.08	...	15.50
Sangre Grande—New Lands estate	2.63	.34	1.99	4.96	14.43
„ Evasdale estate	2.49	.42	3.70	6.61	15.00
„ Grosvenor estate	2.64	.33	3.26	6.23	18.51
„ El Recundo estate	2.64	.30	2.23	5.07	12.48
„ San Francisco estate	2.13	.45	2.89	5.47	17.37
Mayaro—Constabulary Station	1.71	nil	2.00	3.71	16.13
<i>North Coast.</i>					
Blanchisseuse—Constabulary Station	2.22	.25	4.32	6.79	22.02
Grande Rivière—Mon Plaisir estate	2.01	.49	3.23	5.73	19.37
Toco—Aragua House	1.33	.26	2.12	3.71	17.19
„ Constabulary Station	1.15	.06	2.00	3.21	16.19
Point Galera—Light House ... ..	...	...	...	...	13.56
<i>Tobago.</i>					
Tobago—Hermitage estate	2.48	1.12	3.17	6.77	13.44
„ King's Bay „	1.96	1.10	2.78	5.84	14.09
„ Roxburgh „	2.46	.71	2.42	5.60	16.20
„ Lure estate ... ..	...	...	...	...	14.21
„ Botanic Station ... ..	.74	.20	.80	1.74	6.82
„ Government Farm ... ..	.36	.15	.77	1.28	4.66
„ Lowlands estate
„ Friendship „08	7.73
„ Riversdale „	1.31	.21	2.96	4.48	9.87
„ Bon Accord „	6.53

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BULLETIN
OF THE
DEPARTMENT OF AGRICULTURE,
TRINIDAD & TOBAGO.

Issued by the Department and Board of Agriculture



29132/36

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Editor:

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* Acting temporarily as Government Chemist and Superintendent of Agriculture for the Leeward Islands.

Froghopper Investigations.

Special Appointment.

C. B. WILLIAMS, M.A., (Camb.) F.E.S.

DEPARTMENT OF AGRICULTURE.

Agricultural Credit Societies

under Ordinance No. 30, 1915.

Registrar.....W. G. FREEMAN, Director of Agriculture (Acting).*Inspector*.....JOS. E. SEHEULT.

REGISTERED SOCIETIES.

Trinidad. *Date of Registration.*

Diego Martin	...	...	...	October	12, 1916.
Lothians	...	...	...	April	4, 1919.
Malgretout	...	...	...	April	30, 1919.
Petit Morne	...	...	...	April	30, 1919.
Union Hall	...	...	...	April	30, 1919.
Malgretout East Indian	...	...	..	May	26, 1919.
Picton	..	..	...	May	30, 1919.
Petit Morne (Palmyra)	.	...	...	June	13, 1919.
Tarouba (Ne Plus Ultra)		...	...	June	13, 1919.
Union-Marabella	...	...	...	July	10, 1919.
Harmony Hall	...	...	...	July	10, 1919.
Williamsville East Indian	...	...	...	July	10, 1919.
Indian Walk	...	...	...	August	19, 1919.

Tobago.

Pembroke	...	...	...	June	18, 1917.
Scarborough	...	..	...	April	11, 1918.
Delaforde	...	...	...	August	20, 1918.
Mason Hall	...	...	...	December	16, 1918.
Moriah	December	16, 1918.
Charlotteville	February	4, 1919.

Plant Protection Ordinance.

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Reference Library.

THIS Library can be consulted at the Head Office of the Department, St. Clair Experiment Station. It contains standard works on General Agriculture, Horticulture, Botany, etc., and books and periodicals dealing with Cacao, Sugar, Coconuts, Rubber, Cotton, Corn, Fruit, Tobacco, and other crops.

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	{ L. MOTA, Rio Claro.
<i>Laboratory and Field Assistant</i>	W. BUTHN.

* On leave for a year from December, 1918.

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Department of Agriculture.

GOVERNMENT STUD ANIMALS.

THE following are the arrangements for September with regard to Stud animals of the Government Farms in Trinidad and Tobago.

Stallions.

<i>Name.</i>	<i>Class.</i>	<i>Where standing for Service.</i>	<i>Fee.</i>	<i>Groom's Fee.</i>
QUICKMATCH.	Thorough-bred	...Govt. Farm Trinidad	\$ 10.00	60c.
SIR HOBBS...	Thorough-bred Hackney	Govt. Farm	5.00	60c.
SIR HORACE...	Half-bred Hackney	Govt. Farm	5.00	60c.
RILLINGTON SPARTAN.	Cleveland Bay	Govt. Farm	5.00	60c.
MARAT	Thorough-bred	...Roxburgh, Tobago	5.00	60c.

Jack Donkeys.

Monarch	...American Donkey	...Govt. Farm, Trinidad	\$ 5.00	60c.
President	... Do. do.	...Govt. Farm, Tobago	5.00	60c.
Barbados Joe	...	...Govt. Farm, Trinidad	1.20	60c.

Bulls.

A.—AT GOVERNMENT FARMS.

TRINIDAD.			TOBAGO.	
<i>Class.</i>	<i>Fee.</i>		<i>Class.</i>	<i>Fee.</i>
2 Pure-bred Zebu	... \$ 1.20c.			
1 " Jersey	... 2.40c.	1 Pure-bred Zebu	...	\$1.00
3 Half-bred Red Poll	... 1.20c.			
1 Half-bred Holstein	... 1.20c.	1 Half-bred Guernsey	...	1.00
1 Half-bred Shorthorn	... 1.20c.			

B.—AT PUBLIC PASTURES OR ESTATES.

<i>Place.</i>	<i>Class.</i>
Queen's Park Savannah	1 Half-bred Shorthorn; 1 Half-bred Holstein.
Mucurapo Pasture	1 Half-bred Shorthorn; 1 Half-bred Guernsey.
St. Clair Expt. Station	1 Half-bred Holstein.
St. Augustine Estate	2 Half-bred Holstein; 1 Half-bred Guernsey.
River Estate	1 Half-bred Zebu;
San Fernando	1 Pure-bred Holstein; 1 Half-bred Jersey.
Harmony Hall Estate	1 Pure-bred Shorthorn.
Arima	1 Half-bred Jersey.
Tobago, Friendship Est.	1 Half-bred Holstein.

Pigs.

AT GOVERNMENT FARM, TRINIDAD.

White Yorkshire, Poland China, Berkshire, Tamworth \$1.00, and Attendant's Fee 25c.

AT GOVERNMENT FARM, TOBAGO.

Berkshire Fee 50c.

AT ST. CLAIR EXPERIMENT STATION.

Berkshire \$1.00 and Attendant's Fee 25c.

POULTRY.

GOVERNMENT FARM, TRINIDAD.

Eggs of Barred Plymouth Rocks, Rhode Island Reds,
White Leghorns \$1.00 per doz.
Great Kind Pigeons 40c. and 60c. per pair.

GOVERNMENT FARM, TOBAGO.

Eggs of Plymouth Rocks, Black Minorcas, Rhode Island Reds 48c. per doz.
Also Cocks and Pullets of Plymouth Rocks and Rhode Island Reds.

Department of Agriculture.

NURSERY STOCK.

Cacao, Limes and any other plants required in large quantities for delivery for early planting in 1920 should be ordered now; address the Superintendent, St. Clair Experiment Station, or the Officer in Charge Botanic Station, Tobago.

Special quotations at St. Clair for Cacao, Coffee and Limes grown from selected seeds are as follows:—

Plants purchased in lots of 1 to 1,000 plants	} Delivered at Nu series
8 cents per plant.	
Plants purchased in lots of several thousands	} uncrcated.
2½ cents per plant.	
Plants purchased in lots up to 100 at 4 cents per plant.	} Delivered at Railway Station, Port-of-Spain or Queen's Wharf, securely packed in open crates.
Plants purchased in lots up to 1,000 at \$3.50 per 100.	
Plants purchased in lots of several thousands at \$33.00 per 1,000.	

Tobago prices on application at the Botanic Station, Scarborough.

Budded Avocados select varieties at 12 cents, Budded Orange at 24 cents and Grafted Mangos at 24 cents should also be booked.

Budded Cacao 12 cents each or in lots of over 100 at 8 cents.

Limes from beds 1½ cents per plant for lots over 100.

A select stock is also kept of other fruit, ornamental and flowering trees, palms, etc., a list of which can be obtained on application. Large orders must be booked six months previous to the date when the plants are required as large supplies are not kept on hand for casual demands.

Board of Agriculture.

SPRAYING CACAO, &c.

From September to November is the time for spraying cacao trees for the prevention of thrips and black rot; and early in the dry season for the Algal disease, die back, and cacao beetles.

The Board of Agriculture has on hand a supply of bluestone, which is sold to planters at 12 cents per pound, also nicotine sulphate the best insecticide for thrips, which is sold at \$10.70 per gallon.

Men will be provided to superintend any spraying work which estates may wish to have done.

Further information in regard to cost of spraying, etc., and applications for bluestone and nicotine sulphate should be made to

THE SECRETARY,
Board of Agriculture,
Port-of-Spain.

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THE BULLETIN issued quarterly, price sixpence per number or two shillings per annum post free in the Colony. To other subscribers postage extra.

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Vol. XVIII. Pt. 1.—Wither Tip of Limes (Illustrated); Yam Experiments 1918-19; Cultivation of Cotton; Nitrogen Content Cacao Soils; Supposed Cure for Froghoppers; Bedding Plants for Trinidad; Fungous Diseases of Roses (Illustrated); Prize Competitions 1918-19.

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All publications can be obtained from the Head Office of the Department, St. Clair Experiment Station, and sent post free within the Colony.

The Bulletin is also on sale at Messrs. Muir, Marshall, and Davidson & Todd, Port-of-Spain.

BULLETIN
OF THE
DEPARTMENT OF AGRICULTURE
Trinidad and Tobago.

PART 2.]

[VOL. XVIII.]

Froghopper Investigations.—In this number of the Bulletin considerable attention is devoted to recent aspects of the Sugar-cane Froghopper investigations. Mr. C. B. Williams, the Entomologist in charge, had for some time been forming the conclusion that root disease played a more important part in the condition known as "blight" than was usually recognized. At his request Mr. W. Nowell, the Mycologist of the Imperial Department of Agriculture paid a short visit from December, 1918 to February, 1919. Mr. Nowell's report is here given in full with an introductory resumé by Mr. Williams. It has been arranged for Mr. Nowell to pay another visit this year so as to see the canes at the time when the froghopper itself is usually at its worst.

Pending any modifications which his second visit may cause the view held is that "blight" is often due not to froghopper attack alone, but to combined attack of froghopper and root disease, and that until some practical means of exterminating froghoppers can be found, careful attention should be given to improved agricultural methods and field sanitation which would reduce the damage done by root disease.

This does not mean that the froghopper is no longer to be regarded as a serious pest. It is, and every effort should be made to get rid of it also. It means that the froghopper alone does not do all the damage commonly attributed to it, and that root disease is an important contributing agent. As the methods of dealing successfully with root disease are known, they should be applied, even if the necessary increased attention to cultivation, should require a temporary reduction in the area under cane cultivation.

Agricultural Credit Societies.—Since the beginning of the year there has been a gratifying development of Agricultural Credit Societies. Mr. G. Moody Stuart has fostered them on estates of the Ste. Madeleine Sugar Company and twelve registered Societies are now at work in that area, bringing the total number of these Societies at work in the Colony up to nineteen.

A mass meeting of the Ste. Madeleine Societies was held at San Fernando on July 26, when His Excellency the Acting Governor, the Hon. W. Montgomerie Gordon presided. There were some 500 members of the Societies present, who were addressed by Mr. G. A. Jones, Superintendent of the Cane Farmers of the Ste. Madeleine Company, and Inspector of the Societies, Mr. G. C. Wyt, Mr. Jarvis, Manager Colonial Bank, San Fernando, Mr. Ludovic de Vertenil, Mr. W. G. Freeman, Acting Director of Agriculture and Registrar, and His Excellency the Acting Governor.

Mr. G. C. Skinner of the Usine Ste. Madeleine is the Honorary Secretary of all these new Societies. Their formation, resulting as it is hoped will be the case, in active co-operation between the cane farmers, and also between the cane farmers and the factories augurs well for the future of the sugar industry of the Colony.

The Registrar's address appears on pages 47 to 51.

Staff Changes.—Consequent on the return of two members of the staff from Active Service there have been some changes in the Department.

Mr. R. O'Connor has resumed his former post of Manager of River Estate, and Mr. L. Seheult, B.Sc., who acted as Manager during Mr. O'Connor's absence has been appointed Superintendent in place of Mr. J. de Verteuil.

Mr. R. J. Link, formerly Overseer at the Government Farm, Trinidad, has on his return, been promoted to be Manager of the Government Farm and Officer in Charge Botanic Station, Tobago. He has been succeeded at the Government Farm, Trinidad by Mr. L. H. Patterson, who took up the duties of Overseer and Clerk on July 1, 1919.

Ground Provisions Depot.—The trade of the Dépôt continues to increase, and the receipts are now about £500 a month, compared with £150 to £200 a year ago.

The Committee has been informed by the Government that the Secretary of State for the Colonies, has "learnt with satisfaction of the success which has attended the efforts of the Committee."

Empire Day Trees.—The present Director of Education, Mr. H. H. Hancock, M.A. has for the last few years done much to encourage the general improvement of the School gardens of the Colony, by annual competitions, &c. On Empire Day each year the schools have been supplied with decorative or timber trees from the Royal Botanic Gardens.

This year Mr. Hancock circularized the schools to plant a tree on Empire Day to commemorate the year during which Peace was signed.

To mark this year's distributions as distinct from those of previous years, a plant of *Tecoma pentaphylla* or the Pink Poui was sent to all the applicants. As this tree is rarely met with it is hoped that in time to come it will serve as a reminder of this particular year to the schools to which it has been distributed. The following schools received one plant:—Guapo, Williamsville, Los Bajos, San Fernando C.M.I., Princes Town, Grande Rivière, Indian Walk, Arima Boys, Toco E.C., St. Ann's Road, Longdenville, St. Joseph Government, Siparia C.M., Cedros Government, Chaguanas Government, and Mt. Pleasant.

The Pink Poui *Tecoma pentaphylla* is a large tree closely related to the Yellow Poui so common in the hillsides and like it flowering when quite or almost bare of leaves. Each leaf is composed of four or five stalked leaflets of unequal size, the larger about 6 in. x 2½ in. The flowers borne in loose clusters are of a pale rose colour with a yellow throat, fading with age; as the whole tree becomes a mass of blossoms the appearance is very ornamental. The individual trumpet shaped flowers are about 3 in. long, and open during March and April.

Fine specimens of this tree can be seen in flower annually at Couva Railway Station, Tunapuna Recreation Ground, Errol Park St. Ann's, Port-of-Spain. It is a native of Tropical America.

W. G. FREEMAN.

AGRICULTURAL CREDIT SOCIETIES.

CANE FARMERS AND CO-OPERATION.

By W. G. FREEMAN, B.Sc., A.R.C.S.,

Acting Director of Agriculture & Registrar of Agricultural Credit Societies.

AN address at a joint meeting of the members of eleven Agricultural Credit Societies, founded on the estates of the Usine Ste. Madeleine, held at the Victoria Hall, San Fernando, July 26, 1919.

HIS Excellency the Acting Governor, the Hon. W. Montgomerie Gordon presided over the meeting at which about 500 cane farmers, all members of the Credit Societies were present.

To-day's meeting of the members of eleven Agricultural Credit Societies founded in connection with the Usine Ste. Madeleine group of estates, honoured by the presence of His Excellency the Acting Governor marks, I trust, another definite step forward in the Agricultural progress of the colony. It marks the acceptance of the principle of co-operation, or working together for their common good, by the cane farmers, a large and important class of agriculturalists who are taking an increasing share in helping to maintain the sugar production of the colony. Ten years ago the cane farmers grew about one-quarter of all the canes; they now grow about one-half. The future success of the industry thus evidently depends very largely on the continuance of good relationships between the factories and the farmers.

We have just been celebrating the conclusion of Peace, a peace won by great sacrifice of life and money; sacrifices which would not have earned their reward so soon had it not been for the close co-operation of the Allies. The war has taught man many lessons or perhaps has brought home again to him many truths which he was in danger of forgetting. One which I wish you this afternoon to take to heart and to practise, is that summarized in the old proverb "United we Stand, Divided we Fall." You cane farmers to attain success must be united, you must work together, you must co-operate; the co-operation must be not only between cane farmer and cane farmer, but also between cane farmer and the factory owners. "United, the sugar industry of the colony will stand, divided it will fall."

Some people may think now that British grown sugar is admitted into the United Kingdom at a lower import duty than foreign sugar, that all will be well and that they can now take things easily. The Empire, however uses far more sugar than it at present produces and although German and Austrian beet will doubtless never again be admitted on the old terms, we as sugar producers, will meet with very keen competition from producers in other countries, and to meet that competition successfully we must make ourselves more efficient than we are.

Before the war the United Kingdom used every year some 1,800,000 tons of sugar, of which only about 75,000 tons came from British sources. In other words, for every ton of British produced

sugar used in the United Kingdom 28 tons of foreign grown sugar were used, and of these 28 tons, no less than 18 came from Germany and Austria. So serious was the sugar situation that very shortly after the war commenced, the Home Government bought 1,000,000 tons of sugar, about as much as the colony exports in twenty years, and it continued to buy sugar on a similarly large scale during the duration of the war. Now the Government was only able to get very little of the sugar from within the British Empire. It was compelled to go outside and some of the countries to which it went are those with which we have to compete in the future.

CUBAN SUGAR OUTPUT.

For example, Cuba, a West India Island not very far away from us, has made wonderful strides lately. Ten years ago Cuba produced about 1,500,000 tons. This year it is producing the enormous crop of 4,000,000 tons (of 2,000 lb.), as much as we produce in about 70 years. Cuba has several mills each of which makes more sugar than the whole of Trinidad *e.g.* in 1915-16 eleven mills making 40-60,000 tons, three making 60 to 80,000 and two 80-100,000. Cuba, although it has done so well is not resting content but is still working hard to develop its sugar industry and hopes, I see it reported, to reach 8,000,000 within the next ten years. We cannot dream of doing anything on this scale in Trinidad. We have not the land nor the labour. In 1917 our record year, we made nearly 71,000 tons and the cane farmers were paid over \$1,000,000 for their share of the crop. If we could increase our crop to 100,000 tons it would mean at least another \$250,000 in the pockets of the cane farmers.

To this we must increase the capacity of our factories; increase the efficiency of our factories; improve our cultivation, grow the best possible varieties of canes.

The capacity and efficiency of the factories are not within your control as cane farmers. You may, however, rely on the owners doing all they can in these matters. When sugar is paying the more you make the greater the profit. With more efficient milling and a higher recovery of sugar from the juice, less canes are required to make a ton of sugar. This interests you because the factory which has to use 12 tons of canes to make a ton of sugar cannot pay so much for a ton of cane, as the one which can make a ton of sugar from 10 tons of the same quality cane. About 10 tons at the Usine Ste. Madeleine is the best we do in Trinidad but in some other countries a ton of sugar is made from eight or even less tons of cane. In countries where cane farmers work on a larger scale than here it is possible to fix a sliding scale for canes according to the richness of their juice. With our small areas that is not practicable but the factories can control the situation to some extent by refusing to take, or by giving a lower price for canes known to be poor kinds. The way in which you cane farmers can earn more money and make more profit is mainly by giving more attention to your cultivation and so getting more canes to the acre.

A PLEA FOR INTENSIVE CULTIVATION.

There is a tendency all too common in Trinidad for many planters both large and small to attempt to cultivate a larger acreage than they

can do thoroughly. The result too often is very little profit. The man who, if he would cultivate one acre well, might make a good profit, spreads his available labour and money over two acres, and often makes less profit than he would from the one. The Board of Agriculture last year in this district, and again this year at Couva, Chaguanas and Caroni, is endeavouring by means of Cane Farmers' Prize Competitions, under the charge of one of its Agricultural Advisers, Mr. Roach, to help the farmer to get better crops, and so more money for his work. This year the Usine Ste. Madeleine has its own officer, Mr. Jones, Superintendent of Cane Farmers, doing similar work, and is also offering prizes. It is a competition in which you can all get prizes, for a better return of canes is a good prize in itself.

In speaking to you on this subject, I would remind you that the Department of Agriculture practices Cane Farming. During this last season at St. Augustine Estate, we, as others, have been unable to get any artificial manures, and so we have to rely on pen manure, and attention to cultivation. The following figures of our results may be of interest to you.

<i>Acres.</i>			<i>Tons Cane per Acre.</i>	
Plant canes ...	12.68	...	23.70	...
First ratoons...	17.99	...	19.94	...
Second and other ratoons...	39.83	...	17.10	...
Total 69.95 acres with an average yield of 20.07 tons to the acre.				

Now in extending or improving your cultivations, buying additional stock, putting up the new buildings, buying better tools, implements and artificial manures, many of you want money. That is money in addition to what the Estate is ready to advance you for the ordinary cultivation of your canes. It is money which if well spent will bring you in greater returns than you could otherwise expect.

Small cultivators of the Colony who are not members of Agricultural Credit Societies know that it is difficult to borrow money for such purposes at reasonable rates of interest.

They usually are compelled to go to the money lender, who charges such high rates of interest, that the borrower often has little chance of paying back the loan, much less of making larger profits from its use.

GROWTH OF CREDIT SOCIETIES.

The principal object of these Credit Societies is to help you to borrow money at reasonable rates of interest. We had to work a good many years to get such Societies started here, as my friend Mr. Ludovic de Verteuil can tell you, for he was one of the first to try to get these Societies established in the Colony. It is probably 30 years since the first efforts were made. Where there was not active opposition there was often lack of interest, and it has taken very much longer to conquer this opposition and apathy than it did to beat the Germans.

Their development in this district is very largely due, as you know, to the personal interest of Mr. Moody Stuart, who has also in other ways, including the introduction of a sliding scale for your canes, helped to put cane farming on a better basis. Associated

with Mr. Moody Stuart in this good work are Captain Mark Moody Stuart, whom we are glad to welcome back from active service, Mr. Forbes Todd, the Managers of the various estates, Mr. Jones and last but not least, Mr. Skinner, who has undertaken the duties of Hon. Secretary of all your Societies.

We have thus succeeded at last having now 12 societies in Trinidad and six in Tobago, and they will, I believe, increase and flourish to the lasting benefit of the smaller cultivators of the colony, and through them of the large estates and of the whole community. The principles on which they work have been carefully explained to you all. I will therefore only deal now with a few of the more important points.

MEMBERSHIP.

Not everyone can join a Credit Society. He, or she must be an owner or renter of land in the particular district in which the Society works, and must be a person of good character. The latter point is very important for you to remember. Do not admit people who are known not to be honest, and hard working. If you do you may find later, if you have let them borrow money, that they do not put it to proper use, and fail to repay it. Every person of this character is a danger to your Society, and may cause you to be liable for his debts. Let it be an honour to be a member of an Agricultural Credit Society, so that membership may show that you are recognised by your neighbours as being a person of good character.

OFFICERS AND COMMITTEE.

These are very important positions and on the selection of good men much of the success of the Society will depend. All your officers and committee men give their services free, and the thousands of cultivators in Credit Societies throughout the world have great reason for thanks to their officers for their disinterested work. Work loyally and honestly with them and make their task as easy as possible. Here you have been greatly assisted at present by the fact that many of the managers of your estates have been ready to accept responsibilities and duties as Trustees, &c., that Mr. Skinner is working hard as Secretary of all your Societies, and Mr. Jones as Inspector.

SOCIETY BORROWING MONEY.

Why can the Credit Society borrow money from the Colonial Bank, as you do, on better terms than each of you alone? The reason is this. The Bank does not know each of you separately, and cannot afford to have Inspectors all over the Colony to visit each holding, to find out whether the security is good and whether the money, if lent, is being put to proper uses. The Bank will however lend to 50 or 100 of you, selected people of good character, joined together in a Society, registered by the Government and under Government inspection, on the condition that all the members together are liable for the money lent the Society.

You settle at your general meetings how much you will borrow; for that reason you must attend regularly all meetings that are called, because what is agreed on at these meetings is binding on you all and

even if you leave the Society you are still responsible for debts if contracted whilst you were a member.

LOANS TO MEMBERS.

When the Society has borrowed money—it may be \$500, \$1,000, \$2,000, you must remember it is for all practical purposes your own money, and you must take care to lend it out properly. This you do through your own Committee. Only members of the Society can borrow and each has to state in writing what the money is wanted for. The Committee decides whether the use for this purpose is likely to be profitable and only lends the money if quite satisfied. It is here that you can exercise the control impossible to a distant bank. In each Society you are all neighbours, know something of each other's affairs, can judge whether the purpose stated is true and the use of the money likely to be profitable, and, most important, you can easily see whether the money is used for the particular purpose stated. If you find it is not being properly used, the loan can, and should be, promptly recalled. At the same time the Committee, knowing the circumstances of each one can extend a loan if sickness, bad season, diseases or pests or other good reason really prevent the borrower from repaying it at the promised time.

RESERVE FUND.

Build up a good reserve fund out of entrance fees and profits as soon as you can. With this to fall back on, you can later reduce the rate of interest you charge members.

GENERAL.

There are other points I might dwell upon but they are all matters of less importance. What I want you to remember particularly are these:

Admit as members only people of good character.

Attend your general meetings. Understand what you are doing; what sums the Society is borrowing; for you are all personally liable for their repayment.

Select good men for your Committee, because you entrust to them the lending out of the money you have borrowed, money for which you are responsible.

Help the Committee in seeing that loans are used for the purposes stated.

Be prompt in your repayments of any loans and if impossible for special reasons for you to repay at the time an instalment is due, go to the Committee at once and explain why you cannot carry out your promises.

If you keep these few principles steadily in mind and work honestly with one another, your Society will be a success, and you will find it a real help to you at the time when you need money to carry out some useful purpose. Moreover, you will find the Credit Society a means of making the cane farmer more prosperous, and so increasing the welfare of the sugar industry of the Colony and of the Empire.

THE RELATION OF ROOT FUNGUS TO FROGHOPPER
BLIGHT OF SUGAR-CANE IN TRINIDAD.

By C. B. WILLIAMS, M.A., F.F.S.,
Entomologist in Charge of Froghopper Investigations.

THERE appears (pages 57 to 69) a report by Mr. W. Nowell, Mycologist to the Imperial Department of Agriculture for the West Indies, on a visit which he paid to Trinidad in December 1918 to February 1919 to study the occurrence of Root Disease of Sugar-cane in this island, particularly in relation to the condition known as "blight" or "Froghopper blight."

As Mr. Nowell's visit took place owing to my special request to the Froghopper Committee, I have been asked by Mr. Freeman, Acting Director of Agriculture, to give a short summary of the past views on the causes of the disease, the conclusions that I have come to, and, in general, of the events that led up to Mr. Nowell's visit.

The present account is by no means complete as there are a large number of critical and important experiments and observations that I hope to make during the coming season. It will however serve as an introduction to the fuller report that I hope to give next year at the termination of my engagement.

HISTORICAL.

Blight has been known in Trinidad since the middle of the last century; at that time, however, critical investigations were seldom made and the damage was more or less vaguely attributed to unfavourable conditions. H. Cruger in a report dated 1863 (published in *Agricultural Record, Trinidad*. VII. Oct. 1892, 78) considers one of the most important of these as "a want of rain at a certain period."

J. H. Hart (*Agricultural Record*. II, 1890, 126) reports on an outbreak of blight at Chaguanas in 1889, and is the first to mention the Froghopper, which he considers as the prime cause of the injury.

There seems to have been no serious outbreak of blight between this time and 1906, which year was the first of a series of severe attacks. In this year Hart (*Bull. Misc. Information, Botanic Dept. Trinidad* VII. 152) reprinted his earlier report and laid more stress on the presence of root fungi in the blighted areas. He says "on some estates the canes were badly infested with Root Fungus (*Marasmius*) and on these the attack of Froghoppers appeared more pronounced than on other fields where better health prevailed."

In the same year A. E. Collens made two reports on outbreaks of blight at Harmony Hall and Brechin Castle, in which he notes the presence of both root fungi and Froghoppers, and, without definitely stating which he believes to be the more important cause, he gives directions for control which deal with both agents.

In 1909, after three severe outbreaks in successive years, Hart (*Proc. Agr. Soc., Trinidad and Tobago* IX. 82-40) has changed his opinion as to the importance of the Froghopper and now considers that root fungus is at least as important as the insect, the Froghopper being however a contributory cause. He writes "*Marasmius* is usually to be

found among canes that are attacked by Froghoppers, and is usually absent when the canes are not affected" and later "It is now generally accepted that insects . . . attack canes infested with fungus disease more rapidly than healthy plants, and that inclement seasons lead to the spread of diseases and consequently to attacks of insects."

Collens in the same year (*Proc. Agr. Soc.* VIII. 563) writes that the cane "is first attacked by disease and efforts to . . . throw off . . . are rendered ineffective by persistent attacks of froghoppers."

Carmody (*Proc. Agr. Soc.* IX. 1909. 107) writes "whenever Froghoppers are unusually abundant, the canes on closer examination have been found to be diseased from other causes, and the juice is abnormally acid." He suggests that the acid juice may make the canes more attractive to the Froghoppers.

On the other hand other authorities were convinced that the Froghopper is the chief cause of the damage. J. Black (*Proc. Agr. Soc.* VIII. 1918, 565) writes "I have seen no case of blight where the froghoppers have not first been present in large numbers." J. B. Rorer, who had just started his work as Mycologist to the Board of Agriculture writes (Report of the Mycologist August 13, 1909) "The disease called blight here is quite distinct and different from the root fungus in many ways . . . In many worst blighted fields root fungus is present only in very small quantities, or is altogether absent." F. W. Urlich, Entomologist to the Board of Agriculture writes (*Bull. Dept. Agr. Trinidad and Tobago*. IX. 17) "canes attacked by root disease, as well as those entirely free from it, were blighted . . . In every case Froghoppers were present."

From this time onwards, until quite recently, during the investigations of Messrs. Rorer (1909-18), Urlich (1909-1919), Gough (1910-1911), Kershaw (1912-13) and Guppy (1912-14), more and more attention has been paid to the role played by the Froghopper and research was almost entirely directed to its reduction or control. It is true that Gough in his final report (*Dept. Agr., Circular No. 8*. 1912. 11) says "there is evidence to show that fungoid diseases of the cane predispose it to an attack of Froghoppers," but apart from this there is scarcely any further reference to the possible association of the two diseases.

During the first eighteen months of my own work on the Froghopper (1916-1917) I was working, by instructions, on the introduction into Trinidad of new enemies to reduce its numbers, and during that time I had a few opportunities of studying the blight in the cane fields.

In August 1917 it was decided to abandon, at least temporarily, this branch of the work and I was instructed to study the Froghopper in Trinidad "from a wide biological standpoint."

The year 1917 was unfortunately marked by a very severe outbreak of blight, and I soon found that, although Froghoppers were invariably present in blighted fields, yet there was not a strict correlation between the numbers of insects present and the extent of the damage. Certain fields appeared to survive a severe infestation of froghoppers, while others with much fewer were severely damaged. This disparity became very obvious when an attempt was made to find how many Froghoppers were required to cause damage.

It was not until the wet season of 1918 that I was able to get any accurate information on this question, but the results when obtained confirmed the suspicions of the previous year. Two methods were used to get an estimate of the number of Froghoppers present. The first consisted of counting the number of Froghoppers visible on a given number of stools in a field and then calculating the probable total per acre. The second method, which is purely comparative, consisted of finding the number of adults caught in similar light traps placed in different fields.

Both methods are subject to many errors, but the results were too striking to be explained in this way. Fields were badly damaged when only about ten adult froghoppers per stool could be seen at the height of the brood; other fields in which thirty or forty adults per stool could be seen were only slightly injured. One field in which 20,000 adult Froghoppers were captured in one night in four light traps suffered but slightly, while a field in which the numbers never rose above 8,000 was almost completely destroyed.

Results of this kind were a very strong indication that some other factors were involved besides the mere numbers of the Froghopper. Many of these were known—the age of the cane—the soil—the rainfall—manurial treatment—drainage, &c., but although the effect of all these could be seen they were of themselves insufficient to account for the differences found.

Attention was then turned to the possible association of the Froghopper with other insects or with fungi or even the possibility that it introduced some toxic substance into the cane plant. No insect could be found whose presence would explain the conditions, but when a search was made for fungi it was immediately seen that certain species of root fungi were in almost more constant association with the condition known as “blight,” than the Froghopper itself.

In September 1918 Mr. J. B. Rorer visited with me certain fields which had led me to these opinions and agreed that in many of these root fungi were responsible for the greater part of the blight.

In October 1918, as Mr. Rorer was leaving the country, I requested the Froghopper Committee to invite the co-operation of Mr. Nowell, Mycologist to the Imperial Department of Agriculture. As a result he visited Trinidad from December, 1918 to February, 1919 and the following report gives the results of his observations. They are I think of particular value, as he has had considerable experience of the damage due to root fungi in islands where the Froghopper does not occur.

In view of the results of these various investigations I think it can be safely said that root fungi are responsible, directly or indirectly, for a considerable portion of the damage generally attributed to Froghoppers.

RELATION BETWEEN FROGHOPPER AND ROOT FUNGI.

There remains the question as to the relation between the Froghopper and the root fungi. Is each independent of the other? Does the presence of one predispose the cane to the attacks of the other? Or are both dependent on some similar environmental conditions.

Several different types of damage are possible:—

- (1.) Caused by Frog hopper alone.
- (2.) Caused by Root Fungi alone.
- (3.) Root Disease followed by independent Frog hopper attack.
- (4.) Frog hopper followed by independent Root Fungi.
- (5.) Frog hopper attack resulting in increase of Root Fungi.
- (6.) Root Disease resulting in increase of Frog hoppers.

1. We have at present no direct experimental evidence that Frog hoppers alone can cause blight. Several innoculation experiments have been tried by various experimenters but all gave negative results, except one in which conditions resembling blight were produced in potted Para grass by a heavy infestation of frog hoppers. (Heriot. *Proc. Agr. Soc.* VIII. 1908. 550).

There is also still some doubt as to whether it is the nymph or the adult which is the more dangerous. Experiments to test these points will be carried out this season.

In spite of this lack of experimental proof, there is, however, no doubt that Frog hoppers alone, in sufficient numbers, can cause great damage. The severe loss occasioned to plant-canes in years of heavy blight must be due almost entirely to the Frog hopper, as root fungi are seldom found in any quantity in canes during their first year of growth. In such cases, as Mr. Nowell has pointed out in his report, recovery is more rapid than when the situation is complicated by the presence of root fungi.

In addition we know that conditions similar to blight can be produced in other crops (e.g. grass and corn) and in other countries (Colombia, Cuba, British Guiana, &c.) in constant association with Frog hoppers.

2. Damage due to the root fungi alone is sufficiently well established to need little comment. One of the features of such an attack is its close dependence on external conditions such as the rainfall, soil, and general health of the plants, and such a dependence is very noticeable in many of the Trinidad outbreaks.

3-6. In nearly all the cases of blight in Trinidad both Frog hopper and root fungi are present and it becomes the question to decide whether either one of them is responsible for the presence of the other, which is the cause of the greater part of the damage, and which can be most easily reduced.

In the limits of the present preliminary report the evidence for and against these various conditions cannot be detailed, but after two years observations in the field I am inclined to think that the most usual condition is No. 5—that is an attack of Frog hopper followed by, and at least partly responsible for, an attack of root disease. After the Frog hoppers have died out the root fungi persist and may cause the damage to increase out of all proportion to the number of Frog hoppers originally present.

This persistence of the damage after the Frog hoppers have disappeared is a very marked feature of many of the attacks of blight in Trinidad and is one of the strongest arguments that the insect alone is not responsible for all the damage.

I hope to show in a later report on the relation between blight and rainfall, that the most serious outbreaks of blight have occurred in years when the canes first damaged by the association of Froghopper and root fungi have been further held back by drought at the time of the year when they might otherwise have recovered.

PRACTICAL APPLICATION.

The diseases due to root fungi are well known throughout the world, and have been found to lend themselves to treatment the main aspects of which are outlined in Mr. Nowell's report, with whose suggestions I thoroughly agree.

In those cases in which the Froghopper is believed to be responsible for the beginning of the outbreak, it can be argued that the best control would be to destroy the insect itself and so prevent the evil starting. This is undoubtedly true, but after ten years work we are still without any certain and direct means of destroying the Froghopper. There is no knowing at what time some such method may be discovered, but until then much can be done by reducing the amount of root fungus present, so that the Froghopper may have no powerful ally to help him in his destruction and to carry on his work after he is gone.

If one field will give a reasonable crop with thirty Froghoppers per stool, there is no reason why ten Froghoppers per stool in another field should be allowed to destroy it.

It is not too much to say that fifty per cent. of the damage at present caused by blight could be prevented without any alteration in the number of froghoppers.

There will still remain the outbreaks in which the damage is due entirely to the abnormal numbers of insects present, and for the prevention of these we can only look forward to the day when co-operation of the investigator and the planter has produced some reliable and practical method for their treatment.

June, 1919.

REPORT ON AN INVESTIGATION OF FROGHOPPER
PEST AND DISEASES OF SUGAR-CANE IN
TRINIDAD. (1)

By W. NOWELL, D.I.C.,
Mycologist, Imperial Department of Agriculture for the West Indies.

With a covering letter by Sir FRANCIS WATTS, K.C.M.G., D.Sc., &c.
Commissioner of Agriculture for the West Indies.

IMPERIAL DEPARTMENT OF AGRICULTURE FOR THE WEST INDIES,
BARBADOS,
March 4, 1919.

SIR,—In continuance of our correspondence bearing upon the question of diseases of sugar-cane in Trinidad I now have the honour to forward the report by Mr. Nowell as the result of the observations made during his visit to Trinidad in December and January last.

2. When Mr. Nowell's services were asked for in this connexion the investigations, which had been in progress for some time, had reached a stage when it was felt that other factors than the presence of froghoppers were at work causing the serious loss of the sugar crop which was complained of. Mr. Nowell's investigations fully confirm this impression: he finds that the position is complicated by the presence of fungus root disease of the canes, but his observations more particularly go to show that the diseased conditions generally met with are attributable mainly to defective methods of agriculture, and that froghopper and root disease are to be combated rather by general methods of agricultural improvement than by application of specific remedies.

3. I may add that I entirely concur in the views expressed by Mr. Nowell and I venture to hope that his report will prove of material service to those engaged in the sugar industry of the colony. I venture to suggest that it will be well if steps can be taken to give early publicity to Mr. Nowell's report while matters connected with his visit are still fresh in the minds of the agricultural community.

4. As requested in Your Excellency's letter No. 787/1915A of January 28, 1919, I hope to be able to arrange that Mr. Nowell may pay another visit to Trinidad in September next in order to continue his observations concerning these diseases of sugar cane.

I have, &c.,

FRANCIS WATTS,
Commissioner of Agriculture for the West Indies.

His Excellency
Sir JOHN R. CHANCELLOR, K.C.M.G.,
Governor, Trinidad.

Report on a visit to Trinidad
December, 1918-February, 1919.

IMPERIAL COMMISSIONER,

In accordance with your instructions I left Barbados by the Royal Mail Steam Packet "Caraqet" on December 16 for Trinidad, arriving in Port-of-Spain on December 18. I reported myself to His Excellency the Governor on the following day. The question of my return was discussed with His Excellency and the members of the Froghopper Committee on January 16, and the approval of that body was obtained for my return by the Royal Mail Steam Packet "Chaleur," leaving Trinidad February 1 and arriving in Barbados February 8.

2. In company with Mr. C. B. Williams I visited all the areas which were considered likely to provide information on the subject of sugar cane failure.

3. Towards the end of my stay, with the permission of His Excellency the Governor, I spent a few days in the investigation of the so-called root disease of coconuts, as to which a separate report will be made later.

4. The situation which led to the request for my services I understand to have arisen as follows: Mr. C. B. Williams, Entomologist in Charge of Froghopper Investigations, had found that the prevalence in sugar cane fields of the condition known in general terms as blight, in many cases did not correspond with the severity of froghopper infestation. In some cases of severe injury the insect was never present in numbers which appeared to be at all adequate to explain the damage, while in others froghoppers were present in large numbers with much less visible effect on the cane. Mr. Williams reached the conclusion that an additional factor must be involved in the production of blight, and this he came to believe was root disease of fungoid origin. For this reason he desired the co-operation of a mycologist with experience of the effects of root disease in places where no complications with froghoppers exist.

5. At the time of my arrival in Trinidad the froghopper infestation was practically over for the duration of the current crop, and I nowhere saw more than a scanty and scattered remnant. The period of my visit, which covered the last two or three weeks of the wet season and the beginning of the dry, was the most suitable for the estimation of the position held by root disease in the final condition of blighted fields, though it would have been more satisfactory if I could have approached the subject with personal experience of the immediate effects of froghopper activity.

6. From an early stage in the investigation, and without prejudice to conclusions as to the ability of the froghopper to produce serious damage, it became evident that the name of the insect was in popular use to cover practically all the causes which may operate to produce an unhealthy appearance in standing canes. In many fields other adverse conditions were present to a degree which I should unhesitatingly accept as sufficient to account for depression or failure, without any need to bring in the froghopper as an agent. Such conditions do, in fact, regularly produce similar results in all the islands with which I am

familiar, in the absence of the froghopper and often in the absence of notable insect injury of any kind.

7. It is the first necessity of success in meeting the various aspects of blight that a closer discrimination should be applied to the estimation of the causes which in any particular case produce it. For this reason the concentration of attention in recent years on the purely entomological aspect of the subject, while it has so far failed to bring the hoped-for relief, has delayed progress in more promising directions.

8. It is the main object of the present report to contribute to the understanding of the widespread type of failure of the cane crop to which the non-committal name of blight is the best to apply. It ranges, in the examples exhibited to me, from a condition in which whole fields contain nothing but stunted and worthless stools, the cultivation of which has been abandoned, to merely unhealthy fields which will give, in various degrees, reduced returns. There is another type in which the appearance of health is maintained, but development has at some stage been so arrested that the canes look months younger than they really are. In the definitely unhealthy fields the existence of root disease is general, and its prevalence as a rule appears proportionate to the severity of the damage experienced.

9. The key to the correct appreciation of root disease is the fact that both its onset and its persistence depend on a condition of weakness or debility in the cane, that is to say the existence of root disease pre-supposes some unfavourable circumstance which enables it to take effect. The list of the possible pre-disposing causes covers all the adverse conditions to which sugar cane is subject, and a complete discussion of the reasons for its prevalence involves a survey of the whole field of cane cultivation. I propose to deal in three sections with the general nature of root disease, the apparent reasons for its epidemic occurrences in Trinidad, and the means which may be adopted for its reduction.

THE NATURE OF ROOT DISEASE.

10. The name root disease has come to have specific application in the case of sugar cane to conditions which arise from the invasion of the roots, and in severe cases the underground portions of the stool and the young shoots, by the mycelium of certain fungi which normally exist on the decaying cane material in or about the soil.

11. The fungi concerned in Trinidad as in other parts of the West Indies are mainly two, or as it would appear to be more accurate to say, two groups, each comprising two or more closely allied species.

(a) *The Marasmius group.*—This is usually represented by *Marasmius Sacchari*, but the fructifications of other species of *Marasmius* are sometimes seen, occurring under conditions at present indistinguishable. The fruiting bodies, which are developed only under very moist conditions, are small papery toad stools usually less than half-an-inch across. They quickly dry up and disappear on a sunny day, and are rarely seen unless specially sought for. The mycelium of *Marasmius Sacchari* is more or less distinguishable by the appearance it produces of the leaf sheaths being stuck closely together as if with flour paste. There is no approach to the definite and easily recognisable form pertaining to the group next to be described.

(b.) *The Odontia group*.—A white mycelium, easily distinguishable from that of *Marasmius* by its feathery pattern of growth and the production of abundant stellate crystals of calcium oxalate, has long been known as apparently capable of producing effects similar to those of *Marasmius*. It has been commonly referred to as the stellate crystal fungus, and, as a mycelium of unknown affinities, was given the name *Himantia stellifera* by J. R. Johnson. Recently Dr. Burt has described the fructifications of *Odontia Sacchari* and *O. saccharicola* from Porto Rico material: two closely related fungi which produce their spores on cane trash in a close lying granular, buff-coloured layer hardly distinguishable without the aid of a lens from the surface of the dry trash itself. From the constant association and the apparent organic connection of *Odontia* fructifications with the typical stellate crystal mycelium I was led by observations in Trinidad to believe that the two belonged to the same fungus, and I find on reference to *Cane Fungi of Porto Rico* by J. R. Johnston and J. A. Stephenson that the same suggestion has already been made by those authors. The connexion may be regarded as highly probable.

12. The *Odontia* type of fungus appears to be much more common in association with root disease in Trinidad than the *Marasmius* type. The parasitism of both requires detailed investigation. So far as our present knowledge goes their modes of operation may be treated as the same and their effects be referred to without discrimination as root disease. For the sake of simplicity in presentation the mycelium of either or both will be referred to as root fungus.

13. Under certain circumstances, to be detailed later, root fungus is commonly present in healthy fields carrying on an inconspicuous existence. Under conditions favourable to vigorous growth of the cane it is practically harmless, but when the vitality of the plant is depressed and growth is slow the presence of the fungus becomes serious. It enters the growing tips of the young roots, distorting them, stopping their development and causing them eventually to die. It envelops the young shoots in their various stages, hindering their development by cementing the leaf-sheaths, and in severer cases it infests internally the buds, the young shoots, and the underground connections of the stool, and enters to some distance the bases of the developed canes.

14. The general effect produced by the disease is that of shortage of water, which is brought about by interference with absorption by the roots and conduction by the underground stem system. The leaves of affected shoots have their edges rolled inwards when those of healthy plants are expanded; they eventually turn brown from their edges inward, and in order from below upwards until the shoot is withered to the top. The trash, where it has not been stripped, is cemented firmly around the lower joints of the canes, and under it matted roots occur up to a foot or more from the ground, sent out in an endeavour to find the necessary water. When a clump is infested early it has a characteristic stunted appearance and several or many of the shoots may be dead and dry. Infested stools are easily uprooted and exhibit roots which are mostly either dead or lacking in fibrous branches.

THE FACTORS INFLUENCING ROOT DISEASE.

15. In soil which is in good tilth and well-drained, so that roots develop freely and penetrate deeply, root fungus may be present in abundance about the stools of plants or ratoons and, provided the rainfall is not markedly deficient, do no visible harm. This in fact appears to be the regular state of affairs on much of the cane cultivation of Trinidad, where, at least in the Naparimas, it seems to be a quite general custom to plant between the old rows and, much later on, to divide the bank and turn the stools, full of root fungus, over on to the rows of young plants.

16. That this system can in so many cases be practised with impunity is the most convincing testimony that could be adduced as to the suitability of natural conditions in Trinidad for cane cultivation. Its practice involves the assumption that no unfavourable circumstance will occur to give the fungus an opportunity of becoming harmful. The position of the cane plant under these circumstances is that of a man in an unsanitary town depending upon the maintenance of his vigour to keep him free from infection.

17. Where this system of planting is associated with continuous cropping, long ratooning, and the practice of replanting during crop, so that no break of annual production occurs, we have the most extreme form of sugar-cane agriculture obtaining in these islands; one in which root disease, as a factor, is practically left out of consideration. Where it can be carried on with success, as it seems to be on the best parts of several estates I visited, I do not see that any theoretical considerations need be allowed to interfere with its continuation.

18. From this extreme there is, in the West Indies generally, a long series of gradations in agricultural practice corresponding to various degrees of disability of soil or climate, until the opposite extreme is reached, as in the more arid districts of Barbados, in which plant canes only can be grown and these have to be alternated every third, or even in some cases every second, period with a different crop, in addition to the land being thoroughly prepared well ahead of each planting season.

19. The governing factor in all these variations, according to my view of the matter, is the increasing necessity, as conditions grow less favourable, of reducing by preparation and rotation the amount of root fungus to which the plants are exposed, and also reducing, by curtailing ratoons, the period of exposure to the fungus which accumulates on the stools.

20. Discussion of the most general of the unfavourable conditions referred to can be grouped under considerations of soil and climate.

SOIL CONDITIONS.

The physical condition of the soil mainly has effect, as previously mentioned, in its influence on free and deep rooting. On many of the blighted areas, or areas subject to blight, which I visited in Trinidad, there was a conspicuous deficiency in tilth, and this in my opinion, is mainly due to an insufficiency of organic matter in the soil. Sugar cane is not an exhausting crop. It supplies in trash, and in its contribution of fodder to the formation of pen manure, a liberal amount of bulky material to be restored to the soil, and the

mineral constituents of the cane are mostly available for return in the ash. It is when the land is fairly treated in these respects, provided that root disease can be safely ignored, that continuous cane cultivation is possible without exhausting the soil. The soil may in the hands of a capable manager even continuously improve.

21. There is a great deal of cane land in Trinidad that does not appear to have had, in this sense, fair treatment. In these cases either no pen manure or a very inadequate amount has been supplied, and frequently sulphate of ammonia has been used as a supposedly efficient substitute. While this chemical has not the notorious effect of nitrate of soda in directly destroying tilth, a similar result is reached if its use leads to the omission of the organic matter on which the maintenance of tilth largely depends. It has moreover a deleterious action of its own which is set out in A. D. Hall's statement that on soils initially poor in calcium carbonate the removal of this substance by sulphate of ammonia soon induces a condition of actual sterility. Attempts are made in Trinidad to correct by the application of lime the condition of acidity thus produced, but this treatment to be certainly effective should be carried out under scientific control on the lines of recent work on this subject.

22. The idea that the soil is a chemical mixture which can be sufficiently adjusted by adding more chemicals is now completely discredited. An agricultural soil in good condition is a culture of living organisms, mostly bacteria, on the action of which the maintenance of its fertility depends. For this bacterial flora to thrive there are in addition to moisture two requirements: (1) organic matter, which is supplied by mulch, green dressing and pen manure, and (2) air, which gains access through cultivation. How far some Trinidad fields are from this condition is illustrated by cases I saw in which biological activity was so reduced that buried trash and pen manure remained for a lengthy period about as little changed as if soldered in a tin. And yet when a field in this condition goes down there is a tendency to attribute the result entirely to froghopper.

23. On the close-lying, stoneless, silt soils of the plain between the Northern and Central Ranges the question of aeration appeared to me to be of particular importance. A. Howard has recently demonstrated the very great significance of aeration on soils of similar origin in India. The feasibility of special measures for improvement in this direction, as to which a suggestion will be made later, is a matter for experiment to decide.

24. Closely related to aeration is the question of drainage, the importance of which seems to be generally appreciated, though local difficulties in application have not always been overcome. It may be pointed out that poor drainage is well known as a predisposing cause of damage by root disease, operating like the conditions already described by preventing the development of a deep and copious root system.

25. A factor to which my attention was drawn, as contributing seriously in some cases to loss of tilth, is the working of implements in wet weather. It is important that this should be borne in mind, in relation to the present movement towards increasing implemental cultivation. I am convinced that a good deal of harm may be done by

forcing development in this direction before due caution has been learned. Some cases of the occurrence of blight on estates which, in general, are excellently managed were claimed to be due to injury brought about in this way.

26. It is probable that the opposite danger should also be taken into account, though I did not actually see any instance of it: namely, the damage to tilth that results from the reduction of the soil to a dusty consistency by over-cultivation in very dry weather.

CLIMATIC CONDITIONS.

27. One marked advantage which the cane growing districts of Trinidad possess over those of the northern islands lies in the humidity of the air. In the other islands lands which are subject to conditions as favourable in this respect were put under orchard crops when the sugar market was depressed, leaving, with unimportant exceptions, only the drier places, or those with light soils, to sugar-cane.

28. In those islands, of which Barbados may be quoted as an example, the tendency to root disease is largely increased by shortage of moisture. Hence arises the necessity for short ratooning periods or none at all, for rotation, for thorough and clean cultivation, for the conservation of vegetable mulch, and for the use of large quantities of pen manure. These measures have not been so necessary in Trinidad, with a climate more favourable to vegetative vigour, consequently, (since in no industry, least of all that of agriculture, are methods much better than circumstances enforce), they have not been practised. Favourability of climate, however, can be offset by deficiencies in soil conditions, just as its defect can to a considerable extent be compensated for by improvements in the same. The deterioration which has become evident in Trinidad, be its causes what they may, and which finds its expression in the increased prevalence of blight, has now rendered necessary the resort in some degree to similar measures.

THE RÔLE OF THE FROGHOPPER.

29. So far the discussion has proceeded with only casual references to the insect whose prevalence is regarded by many as the beginning and end of the matter. Into the entomological aspect of the case it is not my part to enter, nor as I have explained, was I a witness of the active operations of the pest. The remarks which follow have reference to the opinions which I formed as to its probable share in the production of the conditions of blight as it was visible in December and January.

30. Approaching the subject of froghopper injury with an open mind, I became persuaded from consideration of the evidence that an infestation of froghoppers is capable, in some instances, of quickly producing severe effects, marked by the drying-up of the leaves, on even healthy and vigorous canes growing in rich and well-tilled soil. The history of two cases brought to my notice in districts widely separated had considerable weight in bringing me to this conclusion. Both fields had been attacked and severely damaged as plant canes. The one field had since given, without further attention, two good crops of ratoons and was still, as I saw it, in satisfactory condition. The other field was attacked in 1917, after three years of fallow and the use of pen

manure and sulphate of ammonia. The soil is black and deep and part of the field is a rich and well-drained bottom. The ratoon crop on it was this year exceedingly vigorous.

31. The instances specified illustrate the capabilities of the insect for harm with a clearness which is lacking from the ordinary run of cases, which occur on ratoon crops in which the condition of the canes is usually complicated by root disease and often by cultural disabilities.

32. It is important to note that in these cases, where other conditions were good, recovery seems to have begun as soon as the infestation was over, and no persistent after-effects were experienced.

33. It is, I think, admitted that the effects of the pest are not commonly apparent on plant canes or on canes growing under conditions entirely favourable, and I was led to infer, from the above cases on plants and from the healthy, though delayed, condition of several fields of ratoons which had been infested, that under these circumstances definite recovery, save in the matter of time, is likely to ensue. From this, one must conclude that frog hopper infestation is not capable, without the co-operation of other adverse circumstances of producing the permanently disabled condition which existed on many areas at the time of my visit, and which obviously constitutes the really serious feature of the situation.

34. The facts as to the distribution of blight afford strong support to this conclusion. There are favoured estates on which no injury of the kind has ever been experienced. There are many others with land of unequal quality or unequally treated, in which the trouble, when it has appeared, has always been confined to the poorer fields. The estates on which the trouble is most widespread and frequently recurrent are, in several cases if not in all, subject to disabilities, arising from their situation or from their history, which are perfectly well known to those concerned.

35. There are instances which cannot be included with these, where the trouble has arisen unexpectedly on land as good and as well treated as is commonly found necessary to ensure satisfactory crops. Some of these, I am persuaded, could be accounted for by an intimate study of the conditions prevailing at the time; there are a few, it must be frankly said, in which even the possibility of an explanation on these lines was not evident, at least to a visitor. In a general survey such instances are very far from prominent.

36. The simplest explanation of the severity of frog hopper injury on fields affected by adverse conditions, is that plants lacking full vigour, with an ill-developed root system, are much less able to withstand the drain upon their sap which the feeding of the insects involves. This might account for the general drying-up of leaves which is the first effect of an infestation: I do not see how it can by itself account, in the case of a plant with the powers of recovery characteristic of sugar-cane, for the continuation of the condition after the infestation has subsided. Nor can anything short of a mass infestation be admitted to be capable of even this effect. The exponents of the frog hopper have yet to show how the sucking of the comparatively small numbers of insects sometimes held responsible can affect so hardy a plant apart from a toxic influence of which no evidence has been produced.

37. The first effect of any adverse condition, it has been shown, is to afford an opportunity for the development of root disease; the methods of Trinidad agriculture, it has been further shown, ensure the presence of sufficient root fungus in the fields to take advantage of the opportunity. When a field attacked by frog hopper is already in some degree infested with root disease, or when it becomes so infested in consequence of the effects of frog hopper attack, (as these effects are developed when conditions are already dubious) the permanence of the result is adequately accounted for. Such fields will pass into the condition of blight as I saw it.

38. This conclusion does not carry with it the assumption that all blight is caused in the same way. The final condition is one of infestation with root disease, and a condition as severe as any existing in Trinidad can and does occur where frog hoppers are unknown. In the production of many of the examples I saw, and especially of those in which the damage was most intense, there was no necessity to assume that the insect had taken any effective part.

REMEDIAL MEASURES.

39. There remain for consideration the nature and application of the agricultural practices which, according to the view of the situation put forward, will serve to reduce the injury directly caused by frog hopper and prevent the infestation of fields with root disease. No general prescription can be offered. Each estate, and each varying section of an estate, will need to be considered separately, and modifications in prevailing practice be made to the extent which consideration and experience show to be necessary in each case. The manager of the estate, if he studies his fields, is commonly in the best position to decide concerning these and where more critical comparisons are necessary they can only be supplied by experiments conducted under scientific control.

SANITATION.

40. As regards methods of cropping, the possible variations may be arranged in an ascending scale, beginning from the system of continuous cropping previously described. The departures from this may be regarded in the character of sanitary measures, the object of which is to rid the fields, to the degree found necessary, of vegetable material in the soil which carries on the existence of root fungus. This end is attained in the breaking down of such material and its assimilation by the soil.

41. The first and simplest of these measures comes within the period between the reaping of one crop and the planting of the next, and consists in thorough preparation of the ground. Early ploughing-out of the stools, and the subsequent working of the land so that they are broken up and rotted, will usually suffice for their disposition. Where circumstances do not allow of this being done in time they may be collected and rotted down in heaps. Burning I do not advise because of the loss of organic matter entailed.

42. There is a good deal of land, which it will be understood is that which approaches the best in quality, on which thorough treatment of this kind combined with adequate manuring and cultivation may be expected to supply the necessary margin of safety, and I am inclined to

think that this should be regarded as the minimum for even the best. It is not sufficient to consider whether such treatment is needed in favourable years, but whether its regular adoption is worth while as an insurance against unfavourable ones.

ROTATION.

43. Under less satisfactory circumstances of climate, soil, or soil condition, and this will apply to most of the land now subject to blight, it is necessary to go further and clean up the land thoroughly by leaving out a cane crop, bringing it back into cane by either Spring or Autumn planting according to convenience, in the year following that in which it was reaped, and cultivating it meanwhile in some alternative crop. From the point of view of sanitation, from which the subject is at present being considered, the best crop is the one that involves the most cultivation, for which reason root crops are to be preferred. The choice of rotation crops will be further discussed in another section.

44. The frequency of alternation is again a question of conditions, and is involved with that of the duration of ratoon crops. The choice is open among all the gradations between a practice of clearing up the land at long intervals (which is done at present, in an imperfect and primitive fashion, by throwing out fields when they will no longer bear) and one of interposing a rotation crop at the end of the longer or shorter succession of ratoons which follows each replanting.

RATOONING PERIODS.

45. In some cases it may be found sufficient (again with thorough preparation and manuring) merely to reduce the number of ratoon crops, without rotation; the extreme of this policy being the growing of plant canes only. The last-named measure is worthy of consideration where it is desired quickly to restore a run-down soil.

46. In judging the results of any of these measures there should be taken into consideration, on the credit side, the value of the improvement in the soil, and that of the insurance against blight secured. These values increase step by step with the thoroughness of the policy adopted; in the system of growing only plant canes, for example, the protection against blight is almost complete.

THE CHOICE OF PLANTING MATERIAL.

47. It is highly desirable that the material used in planting should be free from contamination with root fungus, which means that it certainly should not be taken from a field noticeably infested. If cuttings are free from sprouted roots, and top plants have no fungus actually between the leaf-sheaths (cane wax must not be mistaken for fungus) they are presumably satisfactory in this respect.

48. Some of the popular ideas on this subject of selecting cane plants are based on mistaken analogies with selection applied to reproduction by actual seed. It involves a biological fallacy to suppose that cuttings from vigorous plant canes will give anything in the nature of an improved strain as compared with cuttings taken from the scrubbiest ratoons, provided that both are of the same variety. What may perhaps be obtained in this way is a better start for the young plants and a more certain freedom from actual contamination with root fungus. But

provided the canes are clean in the latter respect I know of no established reason why plant canes should be better for the purpose than ratoons. In a well-tilled "seed bed" the young plants when once started seem but little dependent on the support of the cutting, and I think very much better of the prospects of a thin plant under these circumstances than of a fat one in a hard or lumpy soil.

49. In good soil under continuously favourable conditions fine crops have many times been reaped from plants taken, owing to motives of economy, from the worst fields on an estate. But, since continuously favourable conditions can never be counted on, such a policy, so far as it involves the danger of carrying over root fungus, is not one to be recommended.

50. The soaking of the sets in Bordeaux mixture, which was originally recommended as a precaution against the pineapple disease of cuttings, is of very doubtful efficacy against the mycelium of root fungus; in fact, as regards top plants it may without hesitation be set down as useless in this respect.

MANURING.

51. The subject of manuring, while I regard it, together with that of cultivation, as of most importance, is at the same time the one on which owing to the variety and complication of the local factors concerned, it is most difficult to offer more than general counsel.

PEN MANURE.

52. One may start with assurance that much more pen manure should be used: the average manager will heartily agree, but enquire where it is to come from. The question should have the close attention of owners and their representatives, so that liberal expenditure on the construction and modernization of pens may not only be allowed, but an active policy in this direction demanded. Everything should be done for the conversion of the largest possible amount of material into pen manure and for its preservation in good condition. The best means to adopt might, with advantage, be made the subject of a special enquiry. Much improvement on present practice is certainly possible.

53. It would be one of the advantages of rotation of crops that more stock food could be grown on the estate, and this combined with an increase in implemental cultivation would enable more animals to be usefully and economically kept.

54. Connected with the subject of pen manure there is the difficulty in regard to many fields of its transport over traces made impassable to carts for much of the year by mud. This is given, and with obvious justification, as the reason for the remoter areas on some estates being starved. The difficulty is one which from its magnitude can only slowly be removed, and it seems a pity that in the long history of the estates in question no policy has been adopted of gradually building up the traces. Their condition involves a tremendous annual waste of energy and is an effective check to the practice of good agriculture. The army transport services of several great nations have been contending for years with similar difficulties in Flanders, and some of the methods

worked out might find an application in Trinidad. There are sections in the Naparimas where the control of root disease requires the services of an engineer rather than a mycologist, and where a steam roller working on the traces would have more effect on the crop than a steam plough in the fields.

GREEN DRESSINGS.

55. The matter of green dressings is not so simple as it looks, nor so well understood as it might be. There is a good deal that is doubtful as to what happens to the material under various conditions of soil and moisture, and as to the nature and extent of the benefit derived. Recent work in India is throwing some light on these problems.

56. The purpose of the green dressing is threefold: to supply organic matter for the production of humus, to open up the soil for the access of air, and, in the case of leguminous crops, to derive a supply of nitrogen from the atmosphere. The first two purposes are served by any kind of plant material, and where sufficient for the purpose can be produced in connexion with a saleable crop, as is the case with the sweet potato in Barbados, the choice of a legume may be overruled by this consideration, nitrogen being supplied in some other form. If the full manurial effect is needed a leguminous crop should be grown and turned under complete, or better, its produce in the form of peas or beans used as stock food and returned to the soil in this way. If the produce is sold the manurial increment is by so much diminished.

57. Where a green dressing is thickly sown and forms a dense cover the protection of the soil is no small part of its value. The need for aeration in the silt soils of the Colony has already been referred to, and it would appear that in the choice of a green dressing for these lands its effectiveness in regard to this function should be a first consideration. The use of a woody, deep-rooted plant is indicated. I would suggest careful trial of pigeon pea, if it is practicable to get the stems turned deeply into the soil. The decay of such material leaves channels for the access of air, and the results of measures taken to this end in India have been surprisingly good.

MULCH.

58. Sugar cane supplies its own mulch in the form of trash. I got the impression, which may or may not be justified, that in this direction as in others not so much care is taken as in the northern islands to make the most of the benefits available from this material. Like the conservation of pen manure, the best disposition of trash is a matter well worthy of being made the subject of a careful enquiry.

THE CHOICE OF ROTATION CROPS.

59. What is most to be desired for Trinidad agriculture is a rotation crop with a value sufficient to secure, without a sense of sacrifice, its alternation with cane as a general practice. No such crop is at present visible.

60. Among the crops which are available, two lines of development are suggested by the imports of agricultural produce, *i.e.* the production of stock food and of dhol, in both of which there is a trade of very considerable annual value.

61. Of root crops used as food there are sweet potatoes, yams, eddoes, tannias, cassava, and artichokes, all desirable from the point of view of this report as involving considerable cultivation. The prospects for the development of an industry in the production of farine might be considered.

62. Cowpeas and horse beans are already in use, but their position and that of corn is rather that of catch crops.

63. Sea Island cotton is unsuited to the soil and climate the perennial cottons if planted in mass would be likely to suffer too much from stainer-borne disease.

The position of castor is worth watching.

GENERAL.

64. I wish to take this opportunity of saying, in justice to Mr. Williams, Entomologist in Charge of Froghopper Investigations, that the main conclusions here set out are those which he himself had reached or was reaching, though of course I cannot commit him to my expression of them. It is desirable to say this since his report will appear at a later date than mine. If I have been able in the short time at my disposal to approach a correct diagnosis, such a result was rendered possible only by Mr. Williams' services in the selection of the most important points of vantage, and by the opportunity of reference to the data concerning blight which he has accumulated.

65. I have to express my personal thanks for the unfailing consideration and helpfulness with which I was received by all who were concerned with my visit. I am especially indebted to the officers of the Department of Agriculture and of the Board.

66. Finally it will be a matter for real regret if anything I have said is taken as a reflection on Trinidad managers. I have tried to point out that the prevailing practices are the outcome of natural causes, and that they may in fact be regarded as arising from the suitability of the Trinidad climate for cane cultivation. I am far from losing sight of the difficulties entailed in working by hand a large estate on a small labour supply, and considering the circumstances the results attained by the more experienced managers were, to me, something of a revelation.

(Sgd.) WM. NOWELL,
Mycologist.

February 20, 1919.

SUGAR-CANE VARIETIES AND FROGHOPPER BLIGHT IN TRINIDAD.

By C. B. WILLIAMS, M.A., F.E.S.,
Entomologist in Charge of Froghopper Investigations.

IN the course of my investigations into the complex association of diseases known in Trinidad as "Blight" or "Froghopper Blight," the question has often been raised as to the possibility of reducing the damage by finding a variety of cane which is immune or resistant to the disease.

Such a method is obviously of great importance if it can be carried out and for three years I have been collecting notes and observations on the resistance of the different varieties grown in Trinidad during the last ten years, to see if any of them have claims to resistance which can be justified by accurate observations.

The summaries of results given below are based (1) on my own observations in the field, (2) on the replies sent in by the planters in 1912 to a circular sent out asking for areas and varieties of cane damaged in that year, (3) on replies to a somewhat similar circular which I sent out at the beginning of 1918, (4) on various published records.

The particulars given below for over fifty varieties of cane, will serve not only as a basis for discussion as to relative resistance, but may also, in the future, be a guide to the varieties of cane at present in cultivation in the island. With this in view short notes on the appearance of each variety have been added when these could be obtained.

Work has been started on a study of the root systems of the more generally grown varieties on various soils to see if the depth of rooting has any effect on the resistance of the variety to damage by Froghopper and root disease, but sufficient results have not yet been obtained to enable any reliable conclusion to be drawn.

The following sugar-cane planters and authorities, are referred to throughout, by their initials and this opportunity is taken to express my thanks for their co-operation :—

- | | |
|--------------|--|
| A.B. | ...A. Bruce, Manager of Camden, Perseverance and Exchange Estates. |
| A.D.L. | ...A. D. Lyder, late Manager of Plain Palms Estate, Usine Ste. Madeleine. |
| A.M.McC. | ...A. M. McCulloch, Manager of Petit Morne Estate, Usine Ste. Madeleine. |
| A.R. | ...A. Robertson, Manager of Union Hall Estate group, Usine Ste. Madeleine. |
| A.R.L. de B. | ...A. R. L. de Bary, Manager of Bronte Estate. |
| C.A.F. | ...U. A. Forster, Manager of Buen Intento, Malgretout, Friendship group (Tennants and Usine Ste. Madeleine). |
| C.J.B. | ...C. J. Barrilleaux, late Superintendent Mechanical Cultivation, Waterloo Estate. |
| C.C. | ...C. Connell, Manager, Esperanza Estate. |

- C.F.T. ...C. F. Todd, Acting General Manager, Usine Ste. Madeleine Estates.
- C.K.B. ...late C. K. Bancroft, Government Botanist and Asst. Director of Agriculture, British Guiana.
- D.C.A.I. ...D. C. A. Ince, late Manager of Malgrotout Estate.
- D.F. ...D. Farmer, Manager of Forres Park Estate.
- E.E.F. ...E. E. Fabien, Manager of Cedar Hill Estate.
- F.J.M. ...F. J. Morris, late Manager, Forres Park Estate.
- F.W. ...Sir Francis Watts, Imperial Commissioner of Agriculture for the West Indies.
- G.C.R. ...G. C. Ross, Manager of Reform Estate.
- G. H. Hay ...late Manager, Bien Venue Estate.
- G. H. Hill ...late Acting Manager, Petit Morne Estate, Usine Ste. Madeleine.
- G.L. ...G. Liddelow, late Owner and Manager, Craignish Estate.
- G.S.S. ...G. S. Swan, Manager of Cupar Grange Estate.
- H.T.C. ...H. T. Cox, Manager of Hermitage Estate.
- J.B. ...J. Black, late Attorney and General Manager for Waterloo, Exchange, Cunden, &c.
- J.B.H. ...J. B. Harrison, Director of Science and Agriculture, British Guiana.
- J. de V. ...J. de Verteuil, Superintendent of Field Experiments, Department of Agriculture, Trinidad & Tobago.
- J.G. ...J. Gilbert, Manager of Caroni Estate.
- J.J.H. ...J. J. Huldiday, Manager of Pieter and Wellington Estates, Usine Ste. Madeleine.
- J.K. ...J. Knox, Manager of Waterloo Estate.
- J.McP. ...J. McPherson, late Manager of BonLoinond and Friendship Estates.
- J.R.B. ...J. R. Bovall, Superintendent of Agriculture, Barbados.
- J.R.F. ...J. R. Foster, late Manager of La Fortuna Estate.
- J.W.A. ...J. W. Arbuckle, Manager of Brechin Castle Estate group.
- L.A.B. ...L. A. Brunton, Asst. Superintendent Field Experiments, Dept. of Agriculture, Trinidad & Tobago.
- M.M. ...M. Malden, Manager of Williamsville Estate, Usine Ste. Madeleine.
- P. de V. ...P. de Verteuil, Attorney of Woodford Lodge, Estate.
- R.B.McF. ...R. B. McFarlane, late Manager of La Fortuna Estate.
- W.H. ...W. Howard, late Manager of Orange Grove Estate.
- W.H.B. ...W. H. Bolton, Manager of Tarouba Estate, Usine Ste. Madeleine.

BOURBON.

A stout long-jointed yellowish green cane. Leaves somewhat dark and broad. Internodes cylindrical, no channel. Bud rather large round pointed. Shallow rooted with a tendency to trail.

One of the oldest varieties, introduced from Otaheite in the eighteenth century. Began to "break up" owing apparently to fungus diseases at the end of the nineteenth century and has since then been almost entirely replaced by seedlings.

Blight.—Badly damaged, Craignish 1918 (C.B.W.), Caroni 1908 (J.G.). Badly damaged as plants and ratoons Woodford Lodge 1912 (P. de V.) 10 acres badly damaged Harmony Hall 1912 (V.H.B.). Generally worse than the others (G.H.Hill). Have seen badly damaged (J.R.F., J.K., J.B., M.M.) Have seen badly damaged but stands attack about as well as any (J.G.) Slightly damaged Forbes Park 1912 (F.J.M.) Slight damage St. Augustine 1917 (C.B.W.) Slightly damaged Caroni 1912 (J.G.) Not damaged Plein Palais 1912 (A.D.L.), Friendship 1912 (J.McP.) Has more resistance than B. 156 (G.L.) Resistant variety (D.F.) Less severely damaged St. Augustine 1917 (C.B.W.), &c.

BADILLA OR NEW GUINEA No. 15.

A very stout, dark purple cane with broad dark leaves, wax ring below node distinct. Internode short convex, no channel, bud rather small broad and blunt. The resulting cane is short but very hard and heavy. Difficult to mill except in large mills.

Very good root system, few roots above the ground, bulk of roots down to nine inches, many roots penetrate below two feet. General growth of roots decidedly downwards. St. Augustine (J. de V.) Introduced from Queensland in 1909, and hence sometimes called "Queensland" cane in Trinidad.

Blight.—Have seen badly damaged even as plant canes, does not suit our soil, Caroni (J.G.) Slightly damaged Brechin Castle (J.W.A.) Slightly damaged Waterloo (J.K.) Have not seen damage (D.F., J.J.H., J.R.F., C.A.F.) Generally better than the others (J.B.) Resists froghopper attack better than any other variety. Planting round edge of other varieties to protect, Woodford Lodge (P. de V.) Least severely attacked. St. Augustine 1917 (J. de V.) Damage very slight St. Augustine 1917 (C.B.W.) No visible damage St. Augustine 1918 (C.B.W.).

Probably the most resistant variety but not generally liked by the factories.

UBA.

A thin, reed like, yellow to yellowish green cane with long thin rather pale upright leaves. Internodes parallel sided, relatively long, no channel, bud rather large round pointed. Said to be deep rooted. The cane is very hard with large fibre contents and difficult to mill in small mills.

Introduced from South Africa.

Blight.—Have seen badly damaged (C.A.F.) Have seen badly and slightly damaged but recovers better than any (V.H.B.) Damaged at Harmony Hall in 1917 but much better than B. 847 alongside (C.B.W.) Have not seen damaged (J.J.H., J.R.F.) Have seen slightly damaged (G.H.Hill) Now used on Usine Ste. Madeleine for planting on poor soils where other canes will not grow. Suffers but little from root fungi (C.B.W.) Higher and thicker than B. 6450 of same age alongside, Union Hall 1918 (C.B.W.)

Another of the more resistant varieties. Goes down in bad years when nothing survives. Unfortunately not considered good from the factory point of view.

SEALY'S SEEDLING.

Blight.—Badly damaged as plants and ratoons Exchange 1912 (A.B.); six acres ratoons badly injured Waterloo 1912 (J.K.); slightly damaged as plants Pictou 1912 (J.J.H.); slightly damaged as ratoons Union Hall 1912 (A.R.); have seen badly damaged, generally worse than others (G.A. Hill); slightly damaged Harmony Hill 1912 (W.H.B.); have seen badly damaged (C.A.F., J.B.); resistant to root disease in the Leeward Islands (F.W.)

HILL'S SEEDLING No. 1 (Retrench No. 1).

A slightly rusty greenish yellow cane, leaves normal, internode cylindrical, channel very slight or absent, bud rather small flat round, bluntly pointed. Raised by the late Mr. G. H. Hill at Retrench. Brittle and liable to crack between the nodes (C.B.W.)

Blight.—Badly damaged 1917 (plants) and 1918 (ratoons) Corinth (C.B.W.); young plants damaged by froghoppers from field alongside Golconda 1917 (C.B.W.) Have seen badly damaged (W.H.B.) Have seen slightly damaged, generally better than the others (G. H. Hill). Have not seen damaged (J.J.H., J.R.F., C.A.F.) Standing out better than others in mixed farmers cultivation Inverness 1918 (C.B.W.)

HILL'S SEEDLING No. 12 (Retrench No. 12).

Large rusty-orange waxy cane, leaves broad, internodes slightly convex, channel absent, bud large round and pointed.

Raised by the late Mr. G. H. Hill at Retrench.

Blight.—Badly damaged as plants 1917, not damaged as ratoons 1918, Golconda (C.B.W.) No root disease or froghopper on plants, Corinth 1918 (C.B.W.) Have not seen damaged (G. H. Hill).

FOSTER'S SEEDLING (FOSTER'S BEAUTY).

Reddish green to yellow cane, inclined to be thin in ratoons, leaves normal. Internodes cylindrical, furrow distinct to very slight; bud round, rather fat, not very large, broad, bluntly pointed. Raised by Mr. J. R. Foster at La Fortunée.

Blight.—Badly damaged as plants at Golconda 1917, distinctly damaged as 1st ratoons but recovered 1918, (C.B.W.) Not so good as D. 145 supplies La Fortunée 1919 (C.B.W.) Not so good as D. 025 supplies Golconda 1919, (C.B.W.) Have seen badly damaged (C.A.F., J.H. Hill). Have seen slightly damaged (J.R.F.).

WHITE TANNA.

A very upright tall stout yellow cane, leaves erect, internodes long and cylindrical, channel very slight or absent, buds round, slightly pointed. Does not bunch much so might stand closer planting.

Introduced recently from Mauritius where it originated as a bud-sport of Striped Tanna. Only lately distributed from the St. Augustine Experiment Station.

Blight.—Slightly damaged but recovered St. Augustine 1917 (C.B.W.) No visible damage St. Augustine 1918 (C.B.W.)

LOUISIANA PURPLE.

A red cane blotched occasionally with yellow or yellowish green, wax distinct throughout upper internodes. Internodes cylindrical, channel distinct, bud large triangular pointed.

Recently introduced at Waterloo. "Arrows too freely" (A.B.) Has not so far been damaged by blight.

COMMON RED OR CONGO RED.

A bright red cane sometimes with darker red streaks, internodes cylindrical, no channel, bud very small round flat pointed. Now very little in cultivation. Occasionally seen among Farmers canes. Not in favour and often only bought by estates at a low price.

Blight.—Slightly damaged as ratoons, Waterloo 1912 (J.K.) One of the most resistant varieties (J.B.)

WHITE TRANSPARENT.

A grey or pinkish cane with broad dark leaves, inclined to trail. Not much in cultivation in Trinidad to-day.

Blight.—Badly damaged as ratoons, Exchange 1912 (A.B.); slightly damaged as ratoons Waterloo 1912 (J.K.) Suffers slightly from root disease in Barbados (J.R.B.) Not suitable for heavy lands of British Guiana (J.B.E.)

STRIPED EGYPTIAN.

A striped red and yellow cane, darker where shaded than on edge of field. Leaves normal, upper nodes waxy. Internodes cylindrical, channel broad and very distinct. Bud very large and pointed.

In cultivation at Union Hall in 1917-18. No record of damage.

VENEZUELAN BOURBON.

A reddish green cane with thick wax deposit over whole of young internodes. Leaves somewhat broad. Internodes rather short, cylindrical to slightly convex, channel slight or absent, more distinct in young shoots of rapid growth. Bud small, round, rather flat.

In cultivation at Union Hall.

Blight.—Damaged at Union Hall in 1918 (C.B.W.)

ANTIGUA No. 2.

A yellow cane, leaves normal to rather dark. Internodes a little short and cylindrical, channel slight or absent, dark ring below node distinct and waxy. Bud large round pointed.

In cultivation at Union Hall and Petit Morne.

Blight.—Have seen slightly damaged (G. H. Hill). Slightly damaged Petit Morne 1917 (C.B.W.)

D. 78.

Apparently not now in cultivation. Only one record.

Blight.—Severely damaged as plants at Brechin Castle in 1906, following year undamaged (J.W.A.)

D. 95.

Large dark purple, erect cane with long internodes which are channelled. Waxy, eye-buds flat, broad and pointed and very protuberant.

A seedling of White Transparent (Caledonian Queen).

Blight.—Destroyed at Caroni in 1906 (J.G.) Gave 80 tons per acre 5th ratoons in 1905, completely destroyed in 1906 Brechin Castle (J.W.A.) Resistant to root disease in Leeward Islands (F.W.) Badly attacked by root disease in Barbados in 1906 (J.R.B.)

D. 109.

A reddish purple cane with rather dark leaves, the wax ring just below the node distinct. Internodes cylindrical or slightly convex; channel slight to distinct, short; bud small round and rather flat.

Seedling from "*White Transparent*."

In very general cultivation.

Blight.—Badly damaged as plants and ratoons Exchange 1912 (A.B.) Petit Morne 1912 (A.M.M.) Badly damaged Forbes Park 1912 (F.J.M.) Harmony Hall 1912 (W.H.B.) Union Hall 1912 (A.R.) Malgretout 1912 (D.C.A.I.) Friendship 1912 (J.M.) Waterloo 1912 (J.K.) Brechin Castle 1912 (J.W.A.) Caroni 1912 (J.G.) Orange Grove 1917 (C.B.W.) Caroni 1917 (C.B.W.) Caroni 1918 (C.B.W.) Caroni 1908 (J.G.) Badly and slightly damaged but generally picks up quicker than other varieties after an attack (A.B.) Stands attack fairly well but have seen suffer severely (J.G.) Generally better than the others (W.H.B.) A few fields badly damaged at Brechin Castle in 1917 but resists blight fairly well (J.W.A.) Generally better than any other cane I know (G.C.R.) Generally better than others (G.H. Hill). One of the most resistant, in 1917 the froghopper attack spread across the estate but jumped all the fields of D. 109 (H.T.C.) Standing out among B. 347, Reform 1918 (C.B.W.) Standing out among B. 156, Reform 1918 (C.B.W.) Not attacked at Bien Venue and La Fortunée in 1912 even as old ratoons alongside completely destroyed B. 156 (G. H. Hay), &c., &c.

Leaf Disease.—This variety is particularly liable to a leaf disease which, at the end of the wet season causes the leaves to be marked with elongated brown streaks which may coalesce and cover the whole leaf.

Mr. Nowell after a preliminary examination believes the disease to be *Helminthosporium*, known as "eye spot" disease.

Up to the present it has never occurred sufficiently early in the year to cause any serious harm.

In a field of mixed D. 109 and B. 156 at Golconda in 1917 every plant of D. 109 was heavily infected while the leaves of the B. 156 were still healthy and green.

D. 115.

A reddish or greenish orange cane inclined to be blotched with rusty or black patches. Stout, leaves erect. Internodes cylindrical, no channel, buds round and flat.

Blight.—Badly and slightly damaged Exchange (A.B.) Have seen slightly damaged (J.B.) Badly damaged but recovered later St. Augustine 1917 (C.B.W.) No visible damage St. Augustine 1918 (C.B.W.)

D. 116.

Rather thin yellowish green, erect cane with dark leaves. Internodes cylindrical, channel slight or absent, bud large round and flat.

Blight.—Badly damaged as plants and ratoons Caroni 1912 (J.G.) Brechin Castle 1912 (J.W.A.) Exchange 1912 (A.B.) Waterloo 1912 (J.B.) Badly damaged Harmony Hall 1912 (W.H.B.) St. Augustine 1917 (J. de V.). Badly damaged but recovering St. Augustine 1917 (C.B.W.) Distinctly damaged as plants Brechin Castle 1918 (C.B.W.) Badly damaged Caroni 1903 (J.G.) Have seen slightly damaged (G.H. Hill).

D. 145.

Thick heavy dark red or purple cane. Recumbent. Internodes cylindrical. Buds large, prominent and rounded.

Seedling from "Red Ribbon."

Blight.—Badly damaged as plants and ratoons Caroni 1912 (J.G.) Given up, it suffers too much (J.G.) Badly damaged as ratoons Exchange 1912 (A.B.) Badly damaged Harmony Hall 1912 (W.H.B.) St. Joseph 1917 (J. de V.) Slightly damaged as plants and ratoons Waterloo 1912 (J.K.) Not so liable to root disease in Demerara (C.K.B.) Generally better than others (J.B.) Badly damaged by root disease in farmers canes Reform 1918 (C.B.W.) Standing out better among Fosters Seedling La Fortunée 1919 (C.B.W.) No visible damage St. Augustine 1918 (C.B.W.)

D. 866.

A rather narrow, yellow cane with narrow erect leaves. Internodes cylindrical, channel long and distinct. Bud narrow small and pointed.

'Poor root system, bulk of roots down to six inches, few below 18 inches, tend to spread laterally, St. Augustine 1917' (J. de V.)

Blight.—Very badly damaged St. Augustine 1917; worse than D. 504 and B. 156 on either side (C.B.W.) Given it up, suffers too much (J.G.) Root disease severe St. Augustine 1917 (J. de V.)

D. 504.

A large dark red cane with short internodes, leaves dark broad and short. Internodes slightly convex, wax ring below node distinct, no channel. Bud very small round and fat. Cane slightly zig-zag in growth.

A seedling of D. 145.

Blight.—Badly damaged St. Augustine 1917 (J. de V.) Recovered a little later (C.B.W.) No visible damage St. Augustine 1918 (C.B.W.)

D. 625.

A very large and vigorous cane, clear yellow with occasional reddish blotches. Internodes cylindrical, no channel. Bud small round flat pointed.

One of the largest and most striking canes in cultivation but not in general favour at the factories in Trinidad owing to its poor juice. In Demerara on the other hand it composed nearly 50 per cent. of the cane crop in 1917, when 36,000 acres were grown.

Blight.—Badly damaged Harmony Hall 1912 (W.H.B.) Badly damaged as plants Petit Morne 1912 (A.M.M.) Badly damaged as plants and ratoons Picton 1912 (J.J.H.) 15 acres badly damaged as plants Bien Venue (G. H. Hay). Badly damaged as plants and ratoons Malgretout 1912 (D.C.A.I.) Badly damaged as ratoons Exchange 1912 (A.B.) Badly and slightly damaged plants and ratoons Brechin Castle 1912 (J.A.) Badly damaged ratoons, slightly damaged plants Caroni 1912 (J.G.) Badly and slightly damaged plants Woodford Lodge 1912 (P. de V.) Ten acres slightly damaged as ratoons Williamsville 1912 (M.M.) Generally better than the others (J.B.) Have seen slightly damaged, generally better than others (G. H. Hill). Standing up among damaged "Fosters Seedling" Golconda 1919 (C.B.W.) Liable to root disease in Demerara (C.K.B.)

D. 790.

Only one record.

Blight.—Nineteen acres of plants slightly attacked at Caroni in 1912 (J.G.)

D. 1082.

Only one record.

Blight.—Thirty-one acres of plants badly damaged at Caroni 1912 (J.G.)

D. 2468.

Stout dark red-brown to yellowish-brown rusty cane. Very waxy. Leaves broad, stem slightly zig-zag. Internodes cylindrical waxy throughout, slight furrow. Bud rather large broad flat blunt.

'Fair root system, bulk of roots down to six inches, few roots penetrate below 17 inches; roots tend to spread laterally; large number of secondary roots on surface roots St. Augustine 1917' (J. de V.)

Blight.—Very severe, badly damaged St. Augustine 1917 (J. de V.) Root disease fairly bad St. Augustine 1917 (C.B.W.) Always gets root disease (L.B.) Twelve acres of plants badly damaged, Caroni 1912 (J.G.) Slightly damaged at Brechin Castle (J.A.) No visible damage St. Augustine 1918 (C.B.W.)

Leaf Disease.—Much eye spot (*Leptosphaeria*) between D. 504 and D. 145 both almost free St. Augustine 1919 (C.B.W.)

D. 3956.

A somewhat stout, yellow cane. Leaves rather broad and erect. Internodes cylindrical or slightly convex, channel slight or absent. Bud not large, round, slightly pointed.

Blight.—Slightly damaged at Brechin Castle (J.W.A.) Slight root fungus St. Augustine 1918 (C.B.W.)

Leaf Disease.—This variety during 1917 and 1918 suffered at St. Augustine from an unknown disease causing a mottling of the leaves with pale semi-translucent yellowish green spots. The varieties D. 386 and D. 145 on either side were practically free from this condition (C.B.W.)

D. 4897.

Closely resembles Bourbon.

Seedling from Bourbon, raised in 1897.

Blight.—Slightly damaged (J.W.A.) Badly damaged as plants at Caroni 1912 (J.G.)

D. 4805.

Thin yellow cane with red patches, upright. Internodes cylindrical. Buds small, rounded and prominent.

Only one record.

Blight.—Seventeen acres of plants damaged at Caroni in 1912 (J.G.)

T. 146.

Raised from seed D. 116 in 1837 by J. H. Hart. Apparently no longer in cultivation.

Blight.—10 acres badly damaged as ratoons Friendship 1912 (J.M.) Badly damaged as ratoons Exchange 1912 (A.B.) Slightly damaged as ratoons Waterloo 1912 (J.K.) Generally worse than others (J.B.)

T. 247.

Raised from seed by J. H. Hart.

Apparently no longer in cultivation.

Blight.—Badly damaged as ratoons Caroni 1912 (J.G.) Slightly damaged as ratoons Exchange 1912 (A.B.) Waterloo 1912 (J.K.) Have seen damaged (W.H.B.) Generally worse than the others (J.B.)

B. 147.

A fairly upright yellow cane mottled with red. Leaves normal or rather dark. Internodes cylindrical, furrow distinct and long. Bud round and pointed not small.

Blight.—Badly damaged as ratoons Exchange 1912 (A.B.) Slightly damaged as plants and ratoons Waterloo 1912 (J.K.) Slightly damaged as plants Union Hall 1912 (A.R.) Suffers very much at Caroni (J.G.) Slightly damaged at Brechin Castle (J.W.A.) Generally better than others (J.B.) Have seen slightly damaged, generally better than the others (G. H. Hill). Have not seen damaged (C.A.F.), (J.J.H.) Said to be resistant to root disease in the Leeward Islands (F.W.) Plants badly attacked by root disease in Barbados 1906 (J.R.B.)

B. 156.

A yellow cane, leaves rather pale. Internodes cylindrical, no channel. buds round and blunt.

The most generally cultivated cane in Trinidad; known to small farmers as "Seedlings" "Little Roseau" and "Esperanza."

Blight.—Particularly prone to froghopper attack.

Suffers more than any other variety but recovers more rapidly (P.de V.) One of the very worse in a bad attack but if not too badly damaged recovers quickly (J.G.) This cane is the worst I know (G.C.R.) Badly damaged Harmony Hall 1912 (W.H.B.) 90 acres badly damaged and 175 slightly damaged Union Hall 1912 (A.R.) Badly damaged as plants and ratoons Petit Morne 1912 (A.W.M.) Picton 1912 (J.J.H.) Plein Palais 1912 (A.D.L.) Esperanza 1912 (C.O.) Waterloo 1912 (J.K.) Exchange 1912 (A.B.) Woodford Lodge 1912 (P. de V.) Brechin Castle 1912 (J.W.A.) Caroni 1912 (J.G.) Badly damaged Hermitage 1917 (C.B.W.) La Fortunée 1917, 1918 (C.B.W.) Wellington 1917, 1918 (C.B.W.) Williamsville 1918 (C.B.W.) Not so good as D. 109 supplies Reform 1918 (C.B.W.) Better than "Fosters Seedling," alongside La Fortunée 1919 (C.B.W.), &c., &c., &c.

B. 208.

A rusty yellowish green cane, generally covered with wax. Leaves rather large and broad. Internodes slightly bulging, no channel. Bud small, round and pointed.

Blight.—Badly damaged Forres Park (D.F.) Have seen badly damaged (W.H.B.), (J.B.) Badly damaged ratoons Caroni 1912, given up (J.G.) Slightly damaged as ratoons Waterloo 1912 (J.K.) Badly damaged Forres Park 1911 (F.J.M.) Better than others (H.T.C.) Have not seen damaged (J.J.H.), (C.A.F.)

B. 306.

Yellow cane not unlike Bourbon.

Now out of cultivation.

Blight.—Have seen badly damaged (G.H. Hill), (C.A.F.) (J.B.) Badly damaged as ratoons Petit Morne 1912 (A.M.M.) Slightly damaged as ratoons Waterloo 1912 (J.K.) Exchange 1912 (A.B.) Badly damaged as ratoons Caroni 1908, 1912; given up (J.G.)

B. 347.

A rusty yellow cane. Leaves rather dark and erect. Stem slightly zig-zag. Internodes convex, channel slight or absent, bud small and round.

Known to farmers as "Burks."

Blight.—Badly damaged Forres Park 1912 (F.J.M.), Union Hall 1912 (A.R.) Badly damaged plants and ratoons Picton 1912 (J.J.H.), Exchange 1912 (A.B.) Brechin Castle 1912 (J.W.A.) Caroni 1912 (J.G.) Completely destroyed between beds of "Uba" not so bad Harmony Hall 1917 (C.B.W.) Badly damaged as plants Brechin Castle 1913, then four good ratoons from same field (J.W.A.) Badly damaged Hermitage 1917 (C.B.W.), Union Hall 1918 (C.B.W.) Very badly damaged as plants and first ratoons Caroni 1908 (J.G.) Not so good as D. 109 planted alongside, Reform 1918 (C.B.W.) Root disease bad in old ratoons Hindustan 1918 (C.B.W.) Root disease in farmers canes Reform 1918 (C.B.W.), &c., &c., &c.

B. 376.

Reddish green waxy cane with broad leaves rather light in colour. Internodes cylindrical, channel slight or absent. Bud small flat and blunt.

Blight.—Badly damaged as plants and ratoons Exchange 1912 (A.B.) Badly damaged as ratoons Petit Morne 1912 (A.M.M.) Badly and slightly damaged as ratoons Brechin Castle 1912 (J.W.A.) Have seen badly damaged (G.H. Hill), (W.H.B.) Least resistant variety (D.F.) Least severely attacked St. Augustine 1917 (J. de V.) Given up, suffers badly (J.G.)

B. 1758.

A rather narrow yellow cane with light green erect leaves. Internodes cylindrical, channel slight or absent, bud small round and flat.

"Had to give up in St. Kitts because shallow rooted and too easily pulled out by hurricanes (C.F.T.)"

"Fairly good root system, few roots above ground bulk of roots down to seven inches, large number of roots penetrating below two feet, roots tend to grow downward St. Augustine (J. de V.)"

Blight.—Plants badly damaged, Brechin Castle 1912, one of the least resistant varieties (J.W.A.) Badly damaged Tarouba 1918 (C.B.W.) Damage distinct St. Augustine 1917 (C.B.W.) Given up suffers badly (J.G.) Have not seen damaged (J.J.H.), (C.A.F.)

Leaf Disease.—Leaves flecked with semi-transparent pale yellow spots St. Augustine December, 1918 (C.B.W.)

B. 3390.

A yellow upright cane. Leaves erect. Internodes long and cylindrical, channel slight or distinct. Buds small flat pointed.

Blight.—Badly damaged St. Augustine 1917 (C.B.W.) Slightly damaged as ratoons Exchange 1912 (A.B.), Waterloo 1912 (J.K.) Have seen badly damaged (C.A.F.)

B. 3405.

Greenish yellow cane, upright, buds prominent and easily broken off. No longer in cultivation

Blight.—Badly damaged as plants and ratoons Exchange 1912 (A.B.) Slightly damaged as plants and ratoons Waterloo 1912 (J.K.)

B. 3412.

A yellowish green cane. Leaves normal. Internodes cylindrical, rather long. Distinct wax ring below node, no channel. Bud flat rounded.

“Fairly good root system, very few roots above the ground, bulk of roots down to six inches; very few below eighteen inches, roots tend to grow downward, St. Augustine (J. de V.)

Blight.—Badly damaged as ratoons Exchange 1912 (A.B.) Slightly damaged as ratoons Waterloo 1912 (J.K.) Damage distinct, St. Augustine 1917 (C.B.W.) Badly damaged Orange Grove 1917 (C.B.W.) Have seen badly damaged (W.H.B.) Have seen slightly damaged (C.A.F.)

B. 3922.

A tall rather erect yellow cane; leaves upright not broad. Internodes cylindrical, no channel. Bud round, slightly pointed; base of leaves with irritating hairs.

Blight.—Badly damaged at Forres Park (D.F.) No visible damage St. Augustine 1918 (C.B.W.)

B. 6808.

A yellow cane, leaves rather narrow. Internodes cylindrical, no channel. Buds small and rounded.

“Fair root system, a good many roots above ground, bulk of roots down to eight inches. very few roots below two feet, roots tend generally to spread laterally, St. Augustine (J. de V.)

Blight.—Slightly damaged Brechin Castle (J.W.4.) Not damaged Forres Park (D.F.) Distinctly damaged St. Augustine 1917 (C.B.W.) No visible damage St. Augustine 1918 (C.B.W.)

B. 6450.

A yellow cane with dark leaves. Internodes slightly convex, channel slight or absent. Bud large and pointed.

Blight.—Damaged Orange Grove 1917 and 1918 (C.B.W.) Badly damaged Caroni 1918 (C.B.W.) Alongside "Uba" and not so good Union Hall 1918 (C.B.W.) Badly damaged (J.B.), (J.K.), (A.B.), (J.W.A.), (C.A.F.), (W.A.B.), (G. H. Hill.) Suffers less than B. 156 and B. 347 but still far from immune (P. de V.) Does fairly well at Caroni but when attacked is slow in recovery (J.G.) Badly damaged, least resistant variety (D.F.)

B. H. 10 (12).

A dark rusty brown cane with much wax, leaf normal or rather dark. Stem distinctly zig-zag. Internodes convex, no channel. Bud rather small round and flat.

Cultivation at present small but spreading.

No records of damage.

B.A. 6032.

A yellow or slightly reddish yellow cane, of upright growth. Leaves long and erect. Stem distinctly zig-zag. Internodes bulging, no channel. Buds rather large flat and pointed.

Recently introduced and spreading rapidly.

Blight.—No damage at Hernutage (H.T.C.) No damage at Brechin Castle (J.W.A.) No damage at Caroni (J.G.) No damage at St. Augustine 1917 and 1918 (C.B.W.)

The following additional varieties are at present in cultivation at St. Augustine, but are either not found in estates or farmers cultivation, or have been so recently distributed that no records are available of damage:—

L.	218	(1)	B.	4578	B.	4984
L.	511	H. 27	B.	6388	B.	6935
L.	253	H. 146	B.	7169	B.	7482
M.P.	55	II. 227	B.	8600	B.	8660
M.P.	87	...	B.	10650	B.	14761
M.	902	...	B.	16533	B.	16832
M.	1237	...	B.	17380	T.	39
M.	1479	..	T.	75	T.	202

CONCLUSIONS.

The conclusions that can be drawn from a study of the above evidence are not encouraging to any planter seeking a variety of sugar-cane that is immune from disease.

In fact it will be found that every variety that has been in cultivation for any length of time has been severely damaged by the "Froghopper Blight" in some year and in some soils.

(1.) H? A Hawaiian cane of which the number on the label was not decipherable when the original introduction was made.—(W.G.F.)

THERE IS NO IMMUNE VARIETY.—It then becomes a question as to relative powers of resistance. Do some varieties, even if damaged, suffer less severely than others under similar conditions? To this the answer is more hopeful.

In collecting evidence for this branch of the problem it is not enough that fields of two varieties side by side should show a different extent of damage. The canes may be of different age, the fields may have had different treatment, the soil, which, in the Naparimas especially, changes rapidly, may be different in two adjacent fields, or even in two parts of the same field.

Allowing for such conditions there is still distinct evidence that some canes will survive when others are more severely damaged. This difference is usually most strikingly seen in fields of one variety which have been supplied with canes of a second variety. Several examples of this will be found in the above notes.

Thus Hill's Seedling No. 1 was standing out among other canes on a Farmers plot at Inverness; Foster's seedling is not so good as D 145 or D. 625 supplies at La Fortune and Golconda respectively. D. 109 is twice recorded as better than B. 156 and again as better than B. 347; D. 866 is more severely damaged than either D. 504 or B. 156 on adjacent beds at St. Augustine, etc.

Perhaps the most striking example of relative resistance to blight was seen at Harmony Hall in 1917 where a field had been planted with alternate beds of Uba and B. 347. The field was heavily infested with Froghoppers, with the result that while the Uba was damaged sufficiently badly to reduce the crop nearly 50 per cent., the B. 347 almost ceased to exist and the end of the field had the appearance of a castellated wall.

It must be remembered that these relative differences apply probably only to the particular soil and climatic conditions under which the observations were made. On other soils and with different rainfall the difference might be reduced or even inverted.

From a careful inspection of the above results and from personal experience in the field, it is probable that the two most resistant varieties at present in cultivation are *Badilla* and *Uba*. Unfortunately neither of these canes are in particular favour in the factories, as both are very hard with large fibre contents and except in heavy mills do not give good juice yields. In addition neither are suitable for very heavy soils.

Uba cane is being increasingly used by the estates of the Usine St. Madeleine, to grow on small patches of poor soil, along ridges and elsewhere.

Where other canes do not flourish, and under such conditions it has been found to give extremely satisfactory results.

At the Experiment Station St. Augustine, and on some other estates, are to be found a number of recently introduced varieties. Blight does

not seem to trouble the Experiment Plots at St. Augustine to any great extent so that relative resistance cannot be well studied here, but so far as observations have been made the following recently introduced canes seem worthy of more extended trial.

BA. 6032, D.H. 10 (12), White Tanna, H. ?

To summarise, no variety of cane at present grown in Trinidad is immune to "Blight." Uba and Badilla are more resistant than the rest and a few recent introductions are worthy of more extended trial. As evidence shows that there is considerable variation in resistance particular attention should be paid to this in the future with respect to new varieties imported, and particularly in connection with the present work of the Department of Agriculture in raising new varieties from seed in Trinidad.

March, 1919.

PLANT DISEASES AND PESTS.

CONTROL OF THE CACAO THRIPS IN TRINIDAD
AND TOBAGO.

By F. W. URICH,
Entomologist, Board of Agriculture.

(With 16 Figures).

THE following popular account of the Cacao thrips (*Selenothrips rubrocinctus*) and methods of controlling it are intended principally for the use of the small proprietors and drivers on estates :—

WHAT ARE THRIPS?

Thrips are very small insects which belong to the order called Thysanoptera. When young they have no wings but crawl around on the plants on which they live. They have a habit of carrying their excrement in a small drop at the end of their bodies. In the full grown stage they have wings and can fly from tree to tree and even further especially when helped by the wind. In the adult and young stages thrips live by sucking the sap from the leaves of their food plants.

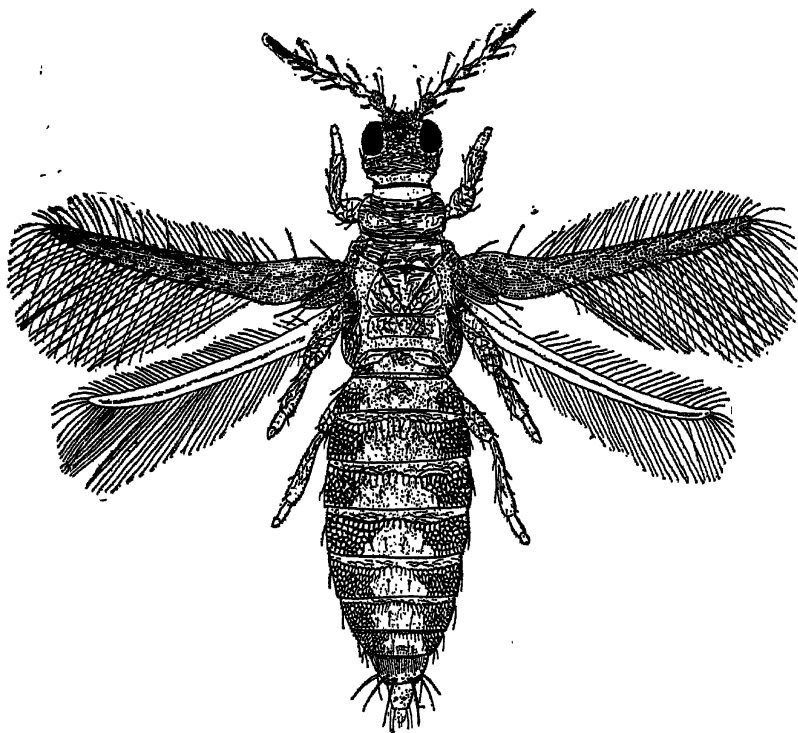


Fig. 1.

Fig. 1.—Adult female thrips, drawing by Mr. C. B. Williams. Greatly enlarged with her wings expanded.—The natural size is about 1-24 of an inch in length of body. Colour jet black.

SUMMARY OF THE HISTORY

Eggs are laid by the female (fig 1) in the tissues of young leaves, they hatch in about 3 to 4 days. In the case of cacao the female lays also in the skin of pods that are newly mature. The young larva (fig. 2) take about 9 days to complete their growth and then turn into prepupa (fig. 3), this stage lasts 24 hours and is followed by the pupal stage (fig. 4) which is completed in 48 hours when adults appear.

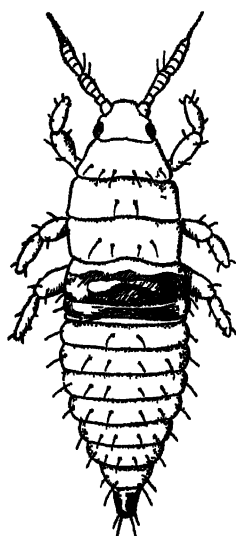


Fig. 2.

Fig. 2—Larval or young stage of thrips. The natural size is about the same as the adult insect when the larva is full grown. Greatly enlarged. Colour light yellow, dark bands shown on drawing in red. Redrawn from Russell.

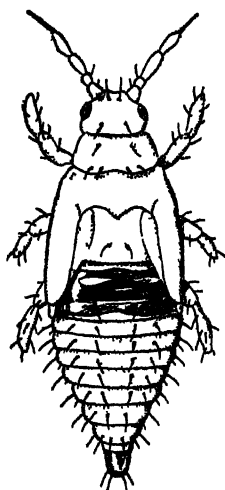


Fig. 3.

Fig. 3—Prepupal stage. Greatly enlarged. Colour and size more or less like larva with red bands. Redrawn from Russell.

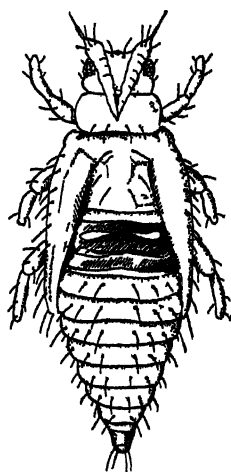


Fig. 4.

Fig. 4—Pupal stage. Greatly enlarged. Colour and size more or less like larva with red bands. Redrawn from Russell.

The total period of development amounts to 12 days from the hatching of the egg to the appearance of perfect insects. The female lays eggs without pausing for several generations and males are not common, occurring only at certain seasons and then not in large numbers. The number of eggs a female can lay is estimated at about 50. The length of the life of a female has not been determined.

but it may occupy several weeks. Related species of thrips have been known to live from 34 to 84 days in captivity. Generation is continuous and every 20 days there can be a new brood. At this rate the increase of thrips is very large and quick and the progeny of a single female might reach a million in a couple of months. See figures 1-4.

FOOD PLANTS.

The cacao thrips is also found on the following plants: hog plum, mango, guava, avocado, almond (*Terminalia catappa*), mammy apple, cashew, roses, pois doux and pomme rose. All these plants are restricted to certain seasons for the putting out of new leaves and thus form continuous favourable breeding grounds for thrips during the whole year. There are many other thrips to be found on the cacao and other plants mentioned, but most of these do no harm. The cacao thrips does not occur in flowers; the black thrips so often found in the flowers of the Bois Immortel and even cacao are different species and are not injurious.

SEASONAL HISTORY OF THRIPS.

As with many other insects the increase of thrips depends on the abundance of its food plants and on the condition of the leaves that are best suited to it. From continued observations since 1909 I find that thrips in all stages prefer the young leaves of their food plants although they can exist on fully mature leaves. Different kinds of trees put out young leaves at different times but a great many, and among these the cacao trees, put out their new shoots and leaves during the rainy season. It is then that the thrips commence their multiplication on cacao. Previous to that and during the dry season thrips will exist on such food plants as put out new leaves then, for example mangos and almonds; or they will attack stray cacao pods or such stray cacao suckers as exist. As far as cacao is concerned we can say that the thrips season begins with the rainy season and that the maximum multiplication takes place just after the heavy rains of May, June and July; roughly speaking it may be stated that thrips begin with the setting of the cacao crop. All the time the leaves are young and not too tough and the rains are still on, thrips remain at the tops of the trees, but when the weather becomes drier they descend to the shaded pods and suckers and can be found on these right through the dry season. A certain degree of moisture appears to be necessary for the well being of thrips. At the height of the dry season they are at their lowest ebb but still never disappear entirely, and if cacao does not offer suitable food they will migrate to other host plants that happen to be in tender foliage at that time. In this connection mangos, almonds, hog plums, and cashew should be watched. During spells of dry weather damage from thrips becomes more apparent, but extensive multiplication and feeding take place during damp weather. In the following table an attempt is made to show the seasonal history of thrips and the food plants on which they are likely to be found. The rainy and dry seasons can only be taken as approximate.

TABLE ILLUSTRATING SEASONAL HISTORY OF THRIPS.

Month.	Season.	Food Plants and parts of them affected.	Remarks.
May ...	Rainy ...	Cacao, leaves on tops of trees.	Heavy rains, thrips not numerous.
June ..	" ..	" ..	" ..
July ...	" ..	" ..	Thrips active and laying eggs when rains abate.
August ...	" ..	" ..	Young stages and adults numerous.
September..	" ..	" ..	" ..
October ..	" ..	also Cacao pods and on leaves of suckers.	Leaves of cacao dropping, when severely attacked, thrips living on pods and suckers.
November..	" ..	" ..	" ..
December...	" ..	also mango & almond leaves.	" ..
January ..	Dry ..	Mangos, hog plum, cashew, guava and roses on leaves.	Thrips decreasing on cacao
February ...	" ..	" ..	" ..
March ..	Very dry ...	" ..	Few thrips in any stage on cacao.
April ...	" ..	" ..	" ..

WHAT BECOME OF THRIPS IN THE DRY SEASON?

Thrips do not disappear altogether during the dry season. The numbers are greatly reduced owing to the want of moisture but they always manage to exist in damp places and on other plants than cacao. The females are not very active in laying eggs during the dry season and most of the thrips pass through this season in the adult stage. It is not possible for eggs to remain dormant in dry leaves on the ground.

HOW DO THRIPS DAMAGE CACAO?

Thrips damage cacao principally by feeding on the sap of the leaves, and when the attack is severe, drying them so much that they appear as if scorched by fire and then drop from the tree. The pods are also damaged, but in this case loss results chiefly owing to discoloration of the skin making it difficult to know whether a pod is ripe or not. When a great many leaves are damaged and have dropped from the trees, the young and half-ripe pods will wither and in this manner the tree will lose its crop and have a set back. See figure 5.

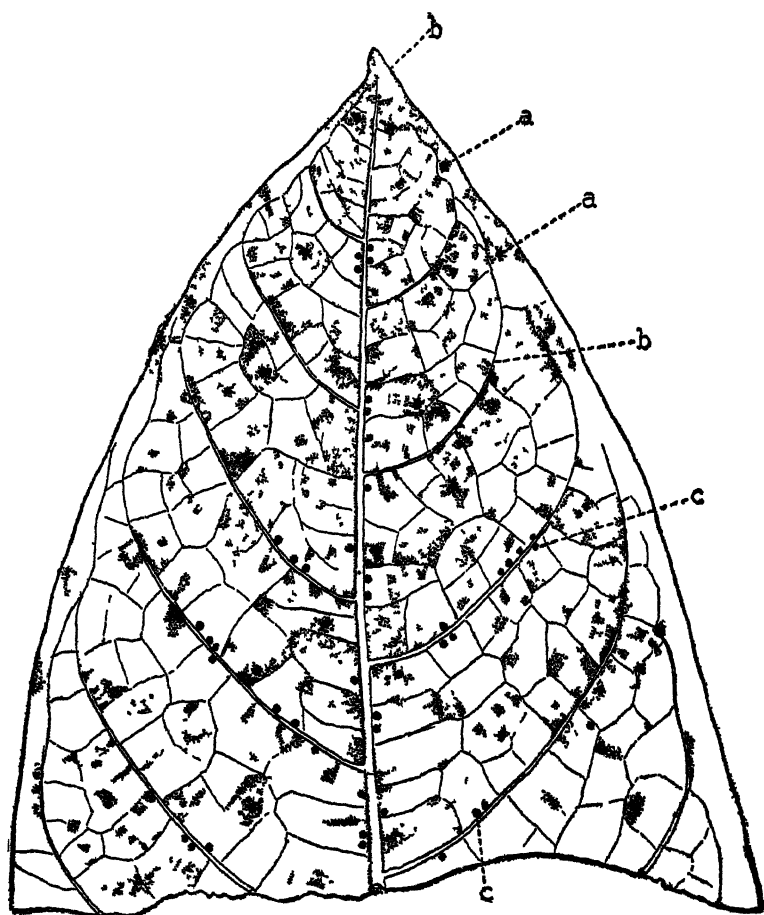


Fig. 5.

Fig. 5—Cacao leaf infested by thrips about natural size showing, (a) excrement spots, (b) feeding marks which are brown and (c) dark brown spots which are dark brown and generally near the veins of the leaf. Original drawing.

ON WHAT PARTS OF THE CACAO TREES ARE THRIPS FOUND?

Thrips are found generally on the underside of the leaves. During the damp season they are to be seen on leaves on the top of trees, but as the season gets dry, they go down nearer the ground, and are then found on the suckers and pods. Sometimes adults and young stages crawl on the upper surface of leaves, but do not remain there long.

HOW CAN THRIPS BE DESTROYED?

Thrips can be destroyed by means of spraying with a suitable liquid applied at the right time of the year. When on the pods, they can also be killed by painting the pods with a suitable liquid. When ripe pods are picked with a great many thrips on them the shells should be buried or covered with earth and not left exposed.

When suckers or chupons are infested they should be cut out and burnt.

WHEN SHOULD THRIPS BE SPRAYED?

Thrips should be sprayed after the heavy rains of June, July and August, but it is very difficult to make hard and fast rules. It is most important that the first broods be destroyed as soon as they appear after the rains. A good time to spray is just after the crop has set properly after the heavy rains. When possible, three sprayings should be given with a month's interval between each.

MANNER OF SPRAYING.

(One of the essential conditions to observe in spraying for thrips is that it must be thoroughly done and a good pressure used. Plenty of liquid should be used, as the whole tree and fruit must be sprayed, taking care that the underside of the leaves is thoroughly wetted. It is necessary that in applying the liquid the nozzle be held close to the leaves of the tree.

SPRAYING OUTFIT.

Any good make of hand pump capable of giving and maintaining good pressure is suitable for spraying cacao thrips. The following are recommended.

FOR SMALL ESTATES.

- 1 Small hand pump of the type of fig. 6.
- 1 Bamboo rod 10-12 ft. long (fig. 8).
- 1 Stop cock for rod (fig. 8).
- 1 Angle nozzle with hole $\frac{1}{8}$ of an inch in diameter (fig. 9).
- 1 Length hose $\frac{1}{2}$ inch bore 25-30 feet in length.

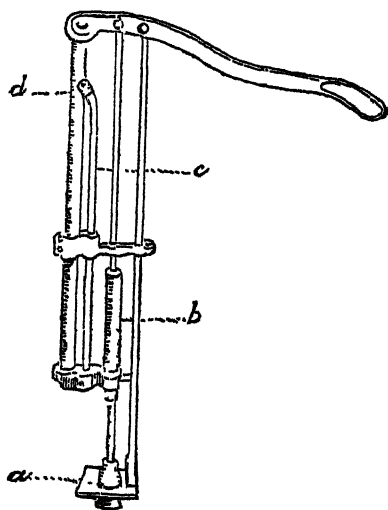


Fig. 6.

Fig. 6.—Small barrel pump (a) agitator, (b) plunger tube, (c) delivery tube, (d) air chamber. Original drawing.

The pump may be mounted on a drum or barrel as shown at fig. 7.



Fig. 7.

Fig. 7.—Small hand pump mounted on 10 gallon iron drum, showing complete outfit in use. Original drawing.



Fig. 8.

Fig. 8.—Bamboo spray rod with stop cock attached.

This outfit is self-contained, light and is easy to use on hilly as well as flat lands. The pump figure 7 is the smallest size made. Larger pumps having outlets for two lengths of hose are also manufactured. When large pumps are used it is preferable to mount them on

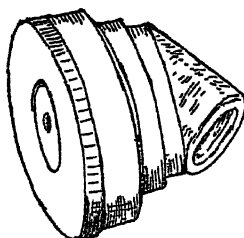


Fig. 9.

Fig. 9.—Friend angle nozzle. Hole in centre should not exceed 1-16 of an inch in diameter.

barrels in the horizontal position as they are then more suitable for hilly districts. All barrel pumps should be provided with agitators. The handles of the pumps are frequently broken by carelessness in pumping and spare handles should always be at hand.

The cost of these outfits according to size of pump and number of leads of hose mounted on barrel or drum was from \$20 to \$50 before the war.

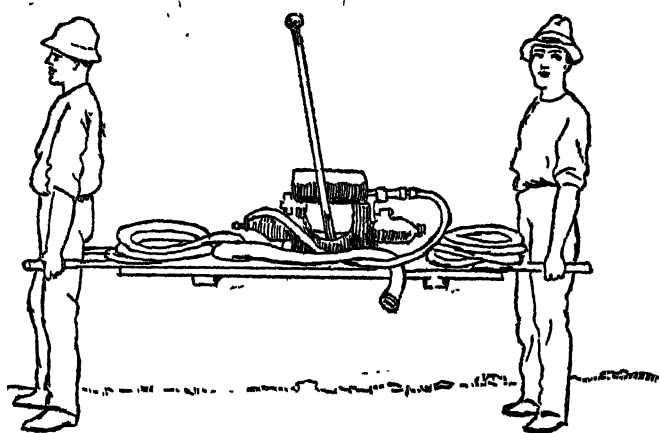


Fig. 10.

Fig. 10. -Double action Friend pump mounted on platform for carrying about.

II. FOR LARGER ESTATES.

- 1 Double action pump mounted on a small platform for carrying about (fig. 10).
- 2 Bamboo rods 10 to 12 feet long.
- 2 Stop cocks for rods.
- 2 Angle nozzles with hole $\frac{1}{8}$ of an inch in diameter.
- 2 Lengths hose $\frac{1}{2}$ inch bore each 50 feet long.

Any size tank, barrel or drum may be used for the spray liquid : The size being regulated by the nature of the district (see fig. 11).

This outfit has the advantage of being stronger and being better able to stand careless pumping.

The pump gives good pressure and when suitable Y pieces are used, four leads of hose can be used. A slight fault is that the agitation of the spray liquid has to be done by hand.

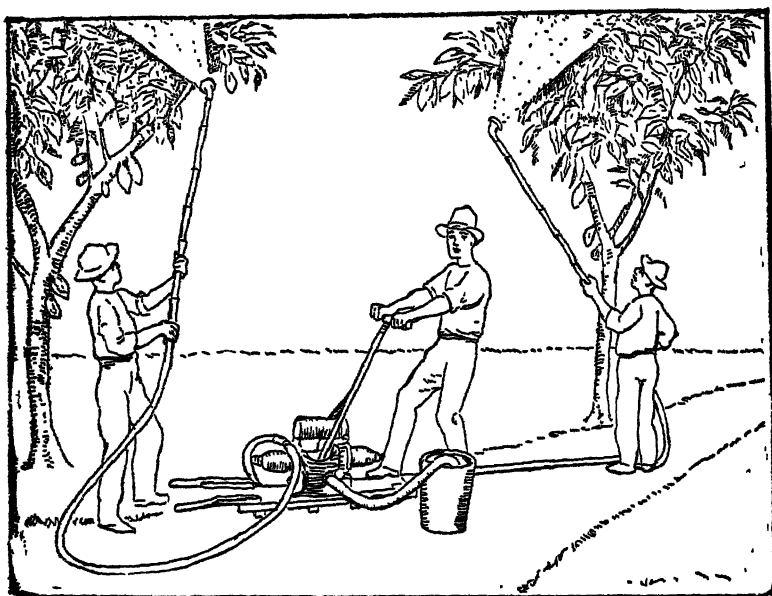


Fig. 11.

Fig. 11.—Double action Friend pump with two leads of hose as used for spraying.

SPRAYING ACCESSORIES.

STRAINERS.

Strainers are one of the important parts of any outfit and the better a liquid for spraying is strained, the better the pump will work and the longer it will last. All solutions should be strained twice; firstly when they are being mixed and secondly before they are poured into the spray tank, barrel or drum. Careless straining means clogged nozzles and delay in work. A good strainer can be made out of any oblong box, the sides of which should be sloping. The wire cloth forming the bottom of the strainer should be fastened on at an angle so as to allow the liquids to pass through better. It is best to use brass wire cloth and the meshes should always be 20 to the inch.

HOSE, HOSE BANDS AND HOSE COUPLINGS.

Only the best rubber hose, specially made for spraying, should be used of $\frac{1}{2}$ inch bore. Ordinary garden hose should never be used as it will not stand the pressure required for spraying.

Couplings, (figs. 12 & 13) having hexagonal nuts are the only ones to use so that an ordinary shifting spanner can turn them. Rubber or leather washers should be used in all connections and couplings.

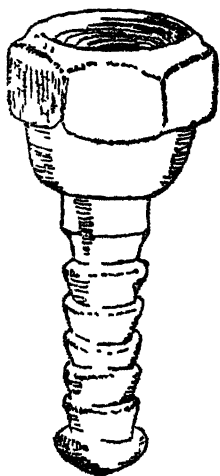


Fig. 12.

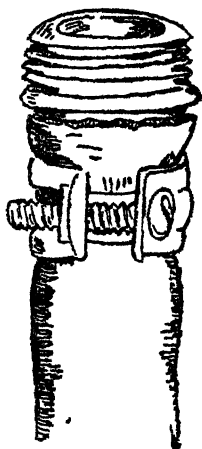


Fig. 13.

Figs. 12 and 13 —Hose couplings

The type of hose band figured (see fig. 14) is the best to use. It is always well to have some extra couplings and hose bands in the field in case of accidents to the hose.

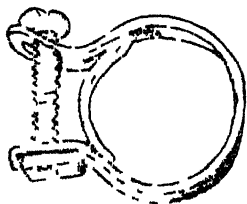


Fig. 14.

Fig. 14 —Sherman hose band made of brass or galvanized iron.

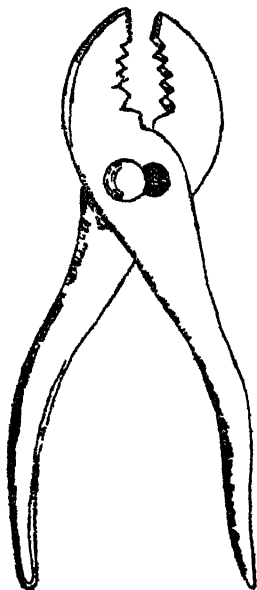


Fig. 15.

Fig. 15 —Pliers useful in spraying work.

RODS, STOPCOCKS, NOZZLES AND PLIERS.

Rods (fig. 8) used for spraying are generally made of brass or copper tubing with a bamboo covering. It is important that the tube be well

secured in the bamboo rod and that it does not turn when the fittings are being screwed up. The length of a rod should not exceed 12 feet for average spraying on cacao estates. Longer rods are very fatiguing to the labourer and when the trees are very tall it is better to use ladders as is sometimes done for pruning or climb the trees.

Stopcocks are very important, a simple and reliable one is represented in fig. 8. The use of a stopcock saves spraying mixture when moving from tree to tree.

An angle nozzle (fig. 9) is the best kind for directing the spray to the underside of leaves where most of the thrips occur. The hole in the disc should not exceed $\frac{1}{2}$ inch in diameter; after long use the hole is apt to wear larger, when a new disc must be substituted.

Fig. 15 represents a useful pair of pliers to have in connection with spraying; a shifting spanner is also useful.

SPRAYING MIXTURES.

Thrips are killed by a contact insecticide, which means that only those insects will be killed which are wetted by the liquid. Sometimes it is advisable to use a combined spray mixture which will act as a fungicide *i.e.* a fungus killer and an insecticide *i.e.* an insect killer as well; in connection with cacao and thrips a mixture of Bordeaux and Blackleaf 40 or Nicotine sulphate has always given very good results. Bordeaux mixture kills moss on the trees and prevents black rot and canker, and Blackleaf 40 kills thrips and other insects.

BORDEAUX MIXTURE.

To make 50 gallons Bordeaux mixture the following ingredients are required:—(see fig. 16).



Fig. 16.

Fig 16.—Method of mixing Bordeaux. Redrawn from Rorer
 Copper sulphate or bluestone—5 pounds;
 Temper lime, in lumps not in powder—5 pounds;
 Water—40 Imperial gallons or 50 American gallons.

Provide two tubs of 25 gallons (American) each; also have ready a cask or tank of 50 gallons (American) capacity. In tub No. 1 which must be filled with strained water dissolve the five pounds of bluestone. If the bluestone is wrapped in a piece of bagging and suspended just below the surface of the water it will melt in a couple of hours without any stirring. In tub No. 2 place five pounds of temper lime and slake it by throwing water on it a little at a time until the lime ceases boiling; then fill the tub with strained water. These two solutions will keep well when left in their tubs. To make Bordeaux mixture stir the contents of Nos. 1 and 2 thoroughly just before the mixture is required and pour the two solutions into the cask No. 3 as illustrated. When properly made the Bordeaux mixture should be of a sky blue colour, any other colour, green especially, appearing shows that there is something wrong with the ingredients or make up. Bordeaux mixture should be used on the same day it is made.

The lime may be slaked in an iron or tin vessel, but the bluestone should never be dissolved in anything but a wooden or earthenware one. For spraying or carrying from the mixing barrel to the spray tank iron or tin buckets may be used.

To make 5 American gallons of Bordeaux mixture take :—

Bluestone	...	...	$\frac{1}{2}$ pound.
Temper lime in lumps	...	...	$\frac{1}{2}$ pound.
Water...	...	...	5 gallons or one pitch oil tin full.

Dissolve the bluestone in a wooden or earthenware vessel in $2\frac{1}{2}$ gallons or half a pitch oil tin of water; slake the temper lime in $2\frac{1}{2}$ gallons of water and pour the two solutions together into a tub or pitch oil tin, as detailed for making 50 gallons of mixture.

NICOTINE SULPHATE OR BLACK LEAF 40.

Nicotine sulphate is a thick liquid of the consistency of molasses. It should not be used with water only as it does not spread enough on cacao leaves. It should always be mixed with Bordeaux, soap, flour paste or resin wash as detailed in the following formulae. The best combinations are with Bordeaux and resin wash.

Formula No. 1.—Nicotine and Bordeaux.—For spraying thrips add to every 50 American gallons (or 40 imperial gallons) of Bordeaux mixture 7 fluid ounces of nicotine sulphate. A quarter lb. capstan tobacco tin makes a handy measure for use in the field as it contains when filled to the top nearly 7 fluid ounces.

To every 5 gallons or one pitch oil tin full of Bordeaux add 5 teaspoonfuls of nicotine.

Add the nicotine to the Bordeaux mixture just before using. Stir well.

Formula No. 2.—Nicotine and Soap—

Ordinary laundry soap	...	...	2 pounds.
Nicotine	...	...	7 fluid ounces.
Water	...	...	50 American galls.

Dissolve the soap in the water then add the nicotine.

Formula No. 3.—Nicotine and Starch Paste—

Starch or Flour	...	...	... 5 pounds.
Nicotine	...	...	... 7 fluid ounces.
Water	...	...	...50 American galls.

Mix up the starch in a little boiling water into a mucilage and then dilute to 50 gallons water. When well mixed add nicotine.

Formula No. 4.—Nicotine and Resin Wash.—For making the resin wash (according to *Farmers Bull.* 908, *U. S. Dept. of Agr.*) take:—

Pulverized resin (rosin)...	...	... 5 pounds.
Lye or Washing soda	...	... 1 pound.
Whale or fish oil	...	...16 fluid ounces.
Water to make total product	...	... 5 American galls.

Place in a suitable cooking vessel the resin, oil, and 1 gallon of water and heat. In the meantime dissolve the lye or washing soda in a little water and after the resin has softened carefully pour in the lye solution. Thoroughly stir the mixture and then add 4 gallons of hot water and boil for about two hours or until the resin wash will unite readily with cold water, making an amber coloured liquid. The total product should be 5 gallons and any water lost through evaporation should be made up with the necessary amount of additional water. For mixing with nicotine take:

Resin wash made up as above	...	.. 2 galls. American.
Nicotine	...	... 7 fluid ounces.
Water	...	.. 50 American galls.

Mix the resin wash with the water then add the nicotine sulphate.

USEFUL MEASURES IN CONNECTION WITH SPRAYING.

1 Pitch oil tin	...	...	= { 4 Imperial galls. 5 American galls.
8 Teaspoonfuls	...	...	= 1 fluid ounce.
16 Fluid ounces	...	...	= 1 American pint.
20 "	...	...	= 1 Imperial pint.
8 Pints	...	...	= 1 gallon.
1 Quarter-pound tin of Capstan tobacco or a tin of 50 Capstan cigarettes			} = about 7 fluid ounces.

SPRAYING HINTS. (a)

Always use fresh temper lime for Bordeaux mixture.

Dissolve bluestone by suspending it in a bag at the surface of the water.

Always strain spray mixtures thoroughly.

Clean the spraying outfits every night after using by pumping water through the hose, rods and nozzles.

Always drain the hose, as water remaining inside will rot it.

Thoroughly agitate all solutions before mixing or using.

Lime juice will remove Bordeaux mixture from the hands.

Spray thoroughly.

SPRAYING DON'TS. (1)

Don't use iron or tin vessels for bluestone solutions.

Don't mix more Bordeaux than required.

Don't use air slacked lime *i.e.* when in powder.

Don't put away machine without cleaning.

Don't make Bordeaux mixture by mixing strong solutions of bluestone and lime and then diluting with water.

Don't try to slake more than 50 pounds of lime at one time in a barrel.

Don't take the stirring rod from the bluestone solution and use in the lime solution or *vice versa*.

Don't become discouraged if things do not go well at first. It takes the labourers a little time to get used to spraying work.

(1.) From Circular No. 4, Board of Agriculture, Trinidad and Tobago.

RICE EXPERIMENTS 1915-1918.

By JOSEPH DE VERTEUIL, F.I.C., F.C.S.,
 Superintendent of Field Experiments, and
 L. A. BRUNTON,
 Assistant Superintendent of Field Experiments.

EXPERIMENTS on the cultivation of rice were started in 1914. During the first two years the experiments were limited to the determination of the comparative yield of four varieties which had been procured, three from British Guiana and the fourth a local variety. The results of the 1914 experiments have already been published. (1) These four varieties have been cultivated yearly and have given the following results :—

Variety.	BARRELS OF 120 LB. PADDY PER ACRE.					
	1914.	1915.	1916.	1917.	1918.	5 years Average.
A.H.C. ...	19.21	12.70	14.77	20.22	21.74	17.73
H. 6 ...	18.13	12.30	10.26	30.03	19.24	17.99
Creole Variant 2 ..	19.87	21.40	9.80	22.45	20.26	18.77
Jerrahan ...	16.28	24.00	13.93	24.79	23.01	20.39

These results were obtained from approximately half-acre plots under adverse conditions; at times the plots suffered considerably from floods or from drought due to the lack of a proper control of the water supply. Although there is very little difference in the average yield for the five years, Creole Variant 2 and Jerrahan are better rice and may be depended to give a yield of 20 barrels of paddy per acre in normal seasons. Jerrahan is a late variety; that is it takes from 4 to 5 months to come to maturity.

In 1917 the following experiments were planned with the object of ascertaining in which direction the yield might be improved :—

1. Early versus late preparation of the land.
2. Distance of planting.
3. Number of plants to a hole.

EARLY VERSUS LATE PREPARATION OF THE SOIL.

This experiment was made with the above four standard varieties in 1917 on duplicate plots of approximately 1.16 of an acre and in 1918 with the Jerrahan variety on duplicate plots of about 1.7 of an acre. The experiment consists in forking and preparing the land in February and June respectively, but the nurseries are transplanted as much as

(1.) *Bulletin, Dept. Agr.* XI. 1915. 162-163.

possible on the same day and otherwise the plots receive similar treatment. The following results have been obtained:—

Variety.	BARRELS OF 120 LB. PADDY PER ACRE.			
	Early preparation.		Late preparation.	
	1917.	1918.	1917.	1918.
A.H.C. ...	21.43	...	18.39	...
H. 6 ..	33.42	...	26.65	...
Creole Variant 2 ...	24.77	...	25.21	...
Jerrahan ...	30.98	25.88	24.49	23.97

With the exception of Creole Variant 2, these results show an increase of from 1.91 to 6.77 bags of paddy per acre in favour of the early preparation of the land.

DISTANCE PLANTING.

The distance planting experiment has been carried out during 1917 and 1918 on duplicate plots of approximately 1.40 of an acre each with variety "A.H.C." Three plants were put in at distances of 4, 6, 8, 10, and 12 inches in the 1917 experiments and distances of 6, 9, 12 and 15 inches respectively in the 1918 plots. The results obtained were as follows:—

DISTANCE PLANTING EXPERIMENTS—VARIETY "A.H.C."

Distance planted.	Brls. of 120 lb. Paddy per acre 1917.	Distance planted.	Brls. of 120 lb. Paddy per acre 1918.
4 inches apart ...	17.89	...	..
6 ,, ...	21.18	6 inches apart ...	24.57
8 ,, ...	26.66	9 ,, ...	28.54
10 ,, ...	30.67	12 ,, ...	29.02
12 ,, ...	20.21	15 ,, ...	27.08

The 1917 results show a steady increase in yield up to 10 inches apart and a slight decrease for the plot planted 12 inches apart. In view of these results a slight alteration was made in the 1918 experiments, starting at 6 inches apart the distance was increased by 3 inches up to 15 inches. The results for this year show an increase in yield up to 12 inches and a decrease on the plot planted at 15 inches apart, but the increase for the 12 inch plot over the 9 inch is very small. The best results therefore for the two years were obtained from plots planted at between 9 and 12 inches; 10 inches apart is probably the best planting distance.

NUMBER OF PLANTS.

This experiment is made with a view of ascertaining the smallest number of plants that may be put to a hole when transplanting the nurseries and consequently economising the nurseries so as to plant up the largest area possible with the smallest number of plants. It is not uncommon to see rice growers planting a handful of plants, containing probably 10 to 15 plants, to a hole, with the object no doubt of obtaining a larger yield per acre. From observations made in the seed selection experiments, as will be seen later, a single plant is capable of producing as many as 50 tillers and the practice of transplanting a large number of plants to a hole points to a large waste of material.

The experiments made in 1917 were a failure owing to several causes, the chief of which were, the irregularity in the soil due to the regrading of the land by removing the surface soil in parts to fill up hollows and the poor water supply in that part of the rice field. The results of the 1918 experiments only will therefore be given. These experiments were made on duplicate plots of approximately 1-30 of an acre with variety Creole Variant 2. 1, 3, 5 and 7 plants respectively were planted one foot apart in each plot with the following results :—

Variety.	Number of Plants to a hole.				Yield per acre barrels of 120lb. paddy.
Creole Variant 2	...	1 plant 1 foot apart	..	..	34.00
„ „	..	3 plants „	...	..	32.46
„ „	...	5 „ „	...	...	35.01
					25.05

Although 5 plants to the hole has given the highest yield it is evident from the above results that a very good yield may be obtained from three and even one plant to a hole. The results tend to show therefore that 2 to 4 plants per hole is likely to give the best results. Single plants may necessitate supplying should there be many failures.

PLANTING AT STAKE.

With a view to economy in planting, trials have been made of planting the paddy at stake direct in the fields as against transplanting and replanting of nurseries. The success of this method is dependent on two conditions, a favourable rainfall at the time of planting and the control of the irrigation water. As the former is an uncontrollable factor, it is only in exceptional cases that planting at stake may be successful. With regard to the latter, as there is no proper control of the water supply the experiments have been a failure either from lack of water or an excess when the plants were small.

IMPORTED VARIETIES.

During the past three years the Department has imported from other countries samples of rice paddy with the object of obtaining new varieties which might give better yields than those grown locally.

Samples of paddy were obtained from Formosa, Ceylon, India, Java, British Guiana and at the end of last year six varieties were received from Louisiana. Unfortunately owing to unfavourable weather conditions and to the lack of control of the irrigation water several varieties were lost either in the nursery stage or after they had been planted out in the field. The results of those that survived are given below:—

1. FROM CEYLON (SWAMP).

Name of Variety.	YIELD OF PADDY PER ACRE— BARRELS OF 120 LB.		Remarks.
	1917.	1918.	
Honderwala .	49·82	33·27	
Hatiel ...	29·40	18·49	
Suduivi ...	24·20	37·20	
Hcemati ...	16·38	Nursery destroy- ed by floods.	Longears, bearded.
Rotuivi ...	14·40		

The above grow well in water up to 3 or 4 feet deep. They ripen late *i.e.* over four months but the seed are very small.

2. FROM INDIA (SWAMP).

Kazla ...	30·25	Destroyed by floods.	{ Bearded. Ripens late. Very weak straw. Falls over as ears develop.
Bazail ...	21·78	34·95	
Kartic Sail ..	16·94	Destroyed by floods.	
Lal ...	16·33	19·05	
Kalai Aman ...	10·89	Destroyed by floods.	
Ial ...	7·56		
Kaijury ...	4·54		
Garfa ..	4·32		

They suffer in more than 2 feet deep of water.

3. JAVA (SWAMP).

Solo Stambock ...	29·24	28·56	Longears, bearded.
Carolina Stambock ..	23·97	41·25	Do. do.

These are good rices. They grow well in water up to 3 or 4 feet deep. Ripen late *i.e.* over 4 months.

4. FORMOSA (SWAMP).

Name of Variety.	YIELD OF PADDY PER ACRE— BARRELS OF 120 LB.		Remarks.
	1917.	1918.	
Oka	18.15	Destroyed by floods.	

5. DEMERARA (SWAMP).

75 Strain 2 ..	27.22	Nurseries lost by floods.	
Creole Strain 2 ...	27.22		
Creole	13.61		
75 Strain 4 ..	6.05		
75 Strain 6 ...	2.86		

6. LOUISIANA (SWAMP).

Nurseries were made with half the seed during the first week of August and transplanted three weeks later, but before the plants were established a large proportion was destroyed by floods. About 2 to 4 lb. paddy of each variety have been reaped.

7. FORMOSA (UPLAND).

	1916.	1917.	1918.
In Riyabu ...	5.6	14.18	10.56
Pe Bi Tsam ...	5.6	8.28	8.37
Fa Na	4.1	4.23	Lost.

The two first are good rices and likely to be useful.

Samples of paddy were also received from British Honduras but the seed did not germinate.

SEED SELECTION.

In addition to the importation of varieties from other countries, attempts are being made to improve the yield and quality of paddy of varieties grown locally by seed selection. A fair amount of attention has been given to this branch of the rice experiments during the past two years.

When the nurseries were sown in 1917, 200 of the strongest plants of the so-called standard varieties: Jerrahan, Creole Variant 2, H. 6 and A.H.C. were pulled up and planted singly one foot apart, leaving a space of four feet between the plots of each variety. When the seed had ripened, 50 plants of each variety were reaped separately, the number of tillers counted and the seed weighed.

The results obtained show that there is a considerable variation in the number of tillers and quantity of seed produced from the plants raised as will be seen in the table below :—

FIRST YEAR'S SELECTION, 1917—50 PLANTS.

Variety.	NUMBER OF TILLERS PER PLANT.			WEIGHT OF SEED PER PLANT IN (GRAMMES.			PADDY PER ACRE BRLS. OF 120 LB.	
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Average.
Jerrahan ...	38	10	19.0	136.31	24.55	61.92	109.05	49.54
Creole Variant 2 ...	38	11	21.9	84.82	23.92	50.44	67.86	40.35
H. 6 ...	37	8	20.0	147.33	9.40	47.17	113.86	37.74
A.H.C. ...	45	13	24.3	108.99	25.73	55.39	87.19	44.31

From the above it will be seen that the average yield per acre for the 50 selected plants is not much higher than that usually obtained from good varieties in a favourable season, but the yield from the best single plant may be three times as high as that of the average yield of the selected plants.

In 1918, the seed from the best plant of the previous year was planted in a separate nursery and 200 of the strongest plants were planted singly one foot apart. When these were ripe, 50 of the best plants were again reaped separately, the numbers of tillers counted and the seed weighed with the following results :—

SECOND YEAR'S SELECTION 1918—50 PLANTS.

Variety.	NUMBER OF TILLERS PER PLANT.			WEIGHT OF SEED PER PLANT IN (GRAMMES.			PADDY PER ACRE BRLS. OF 120 LB.	
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Average.
Jerrahan	46	20	30.4	99.8	40.32	62.90	79.66	50.32
Creole Variant 2	89	16	54.5	173.26	36.05	104.45	138.61	83.56
H. 6 ...	26	12	19.2	77.46	32.07	53.04	61.97	42.43
A.H.C. . .	57	17	36.8	135.56	38.19	84.63	108.45	67.70

If the results of the second year's selection are compared with those of the first year it will be seen that not only has a larger average numbers of tillers per plant been obtained but also a larger yield from the best plant and from the average of the 50 selected plants. It is hoped that by continuing this selection of the best plant yearly a strain or strains of rice may be obtained which will give much larger crops of paddy than is now obtained.

AGRICULTURAL LEGISLATION.

TRUCK ORDINANCE 1918.

TRINIDAD AND TOBAGO.

No. 34.—1918.

I ASSENT,

[L.S.]

J. R. CHANCELLOR,
Governor.

20th December, 1918.

AN ORDINANCE to prohibit the payment of wages otherwise than in money.

[By Proclamation.]

Be it enacted by the Governor of Trinidad and Tobago with the advice and consent of the Legislative Council thereof as follows :—

1. This Ordinance may be cited as the Truck Ordinance, 1918.

2. In this Ordinance unless the context otherwise requires :

“Employer” includes any master, manager, foreman, clerk or other person engaged in the hiring, employment or superintendence of the service work or labour of any labourer within the meaning of this Ordinance ;

“Labourer” means any person employed for wages in work of any kind, and whether under or above the age of 21 years, but does not include domestic servants.

“Money” means coin of the realm current in the Colony, and includes Government Currency notes and the notes of any banking corporation carrying on business in the Colony ;

3. In every agreement or contract for the hiring of any labourer or for the performance by any such labourer of any work within the Colony, except as otherwise provided in this Ordinance, the wages of such labourer shall be made payable in money and not otherwise, and if in any such agreement or contract the whole or any part of such wages shall be made payable in any other manner, such agreement or contract shall be illegal, null and void.

4. No employer shall directly or indirectly by himself or his agent, impose as a condition, express or implied, in any agreement or contract for the employment of any labourer any terms as to the place or the manner in which, or the person with whom, any wage or portion of wages paid to the labourer are or is to be expended, and every agreement or contract between an employer and a labourer wherein any such terms are expressed or implied shall be illegal, null and void.

5. Except where otherwise permitted by the provisions of this Ordinance, the entire amount of the wages earned by or payable to any labourer in respect of any work done by him shall be actually paid to him in money, and every payment of or on account of any such wages made in any other form shall be illegal, null and void.

6. Nothing in this Ordinance contained shall render illegal an agreement or contract with a labourer for giving to him food, a dwelling place or other allowances or privileges in addition to money wages as a remuneration for his services.

7. Nothing in this Ordinance contained shall be held to apply to any body of persons working on an agreement of co-operation.

8. Every labourer shall be entitled to recover in an action so much of his wages exclusive of sums lawfully deducted in accordance with the provisions of this Ordinance as shall not have been paid to him in money.

9. Nothing in this Ordinance contained shall extend or be construed to extend to prevent any employer of any labourer or agent of such employer from making any stoppage or deduction from the wages of such labourer for or in respect of any tools and implements to be used by such labourer in his occupation as such, or for land rent then due and payable.

10. Nothing in this Ordinance contained shall be construed so as to render illegal deductions from wages of fines incurred by labourers under any contract or regulations governing their employment or in respect of negligent work or injury to materials.

11. Whenever any advance of money or of any of the articles specified in Section 9 hereof is made by an employer to a labourer it shall not be lawful for the employer to make any deduction in respect of such advance on account of poundage, discount, interest, commission or any similar charge.

12. Nothing in this Ordinance contained shall be held to apply to any immigrant under indenture.

13. If any employer or his agent contravenes any of the foregoing provisions of this Ordinance, such employer or agent, as the case may be, shall be guilty of an offence against this Ordinance, and shall be liable on summary conviction to a penalty not exceeding £5 for the first offence, to a penalty not exceeding £10 for the second offence, and in case of a third offence such employer or agent shall be deemed guilty of a misdemeanour and on conviction thereof shall be punishable by a fine not exceeding £50.

14. All offences under this Ordinance punishable on summary conviction shall be prosecuted before a Magistrate in the manner set forth in the Summary Conviction Offences (Procedure) Ordinance, 1918.

15. This Ordinance shall commence on a day to be fixed by the Governor by proclamation in the *Royal Gazette*.

Passed in Council this Twenty-ninth day of November, in the year of Our Lord one thousand nine hundred and eighteen.

J. M. FARFAN,
Acting Clerk of the Council.

LABOUR EXCHANGES ORDINANCE.

TRINIDAD AND TOBAGO.

No. 13.—1919.

I ASSENT,

[L.S.]

W. M. GORDON,
Acting Governor.

2nd June, 1919.

AN ORDINANCE to provide for the establishment of
labour exchanges.

[2nd June, 1919.]

BE it enacted by the Governor of Trinidad and Tobago with the advice and consent of the Legislative Council thereof as follows:—

1. This Ordinance may be cited as the Labour Exchanges Ordinance, 1919.

2. In this Ordinance "labour exchange" means any office or place used for the purposes of collecting and furnishing information, either by the keeping of registers or otherwise, respecting employers who desire to engage workmen and workmen who seek engagement or employment.

3. The Governor may establish and maintain labour exchanges in such places as he thinks fit, and may appoint managers thereof and such other officers as he may think fit, at such salaries as he with the consent of the Legislative Council may from time to time fix.

4. The Governor may make regulations with respect to the management of labour exchanges established under this Ordinance, and such regulations may authorise advances to be made by way of loan towards meeting the expenses of workmen travelling to places where employment has been found for them through a labour exchange.

Such regulations shall be laid before and be subject to the approval of the Legislative Council, and shall when so approved be published in the *Royal Gazette*.

5. If any person knowingly makes any false statement or false representation to any officer of a labour exchange established under this Ordinance, or to any person acting for or for the purposes of any such labour exchange, for the purpose of obtaining employment or procuring workmen, or for the purpose of preventing any employer from obtaining workmen, or any workman from obtaining employment, that person shall be liable in respect of each offence on summary conviction to a fine not exceeding £10.

Passed in Council this Sixteenth day of May, in the year of Our Lord one thousand nine hundred and nineteen.

J. M. FARFAN,
Acting Clerk of the Council.

HABITUAL IDLERS ORDINANCE.

TRINIDAD AND TOBAGO.

No. 7. —1918.

I ASSENT,

[L.S.]

J. R. CHANCELLOR,
Governor.

27th April, 1918.

AN ORDINANCE to provide for the discipline and reformation of habitual idlers.

[By Proclamation.]

BE it enacted by the Governor of Trinidad and Tobago with the advice and consent of the Legislative Council thereof as follows:—

1. This Ordinance may be cited as the Habitual Idlers' Ordinance, 1918.

2. In this Ordinance, unless the context otherwise requires:—

“Habitual idler” means any male person who has no visible lawful means of subsistence and who, being able to labour, habitually abstains from work.

“Habitually abstains from work,” and cognate expressions, as applied in this Ordinance to any person, means that such person, during the 7 days immediately preceding the laying of a complaint against him, or his arrest, under this Ordinance, has not worked for a period of 4 hours during each of 3 such days or for a period of 14 hours during such period of 7 days;

“Constable” means a member of the Constabulary Force.

3. A constable may sue out a summons from a Magistrate or Justice calling upon any person whom he has reasonable cause to suspect of being a habitual idler to appear before a Magistrate to answer why he should not be dealt with as a habitual idler.

4. A constable may demand the name and address of any person whom he has reasonable cause to suspect of being a habitual idler; and if such person neglects or refuses to give his name or address as aforesaid or gives a name or address which the constable has reasonable grounds for believing is incorrect, the constable may arrest such person and take him before a Magistrate or Justice to be dealt with according to law.

5.—(1.) On the appearance before a Magistrate of any person who is charged with being a habitual idler, such Magistrate shall hear and determine the charge.

(2.) The prosecutor shall not be bound to prove that such person has no visible lawful means of subsistence or habitually abstains from work, but it shall be for such person to prove that he has lawful means of subsistence or that he does not habitually abstain from work.

6.—(1.) If the Magistrate decides that any such person is a habitual idler, he shall inform him of the fact, but shall adjourn the proceedings for a month or for such further period as to the Magistrate seems proper, to allow of such person obtaining or endeavouring to obtain work during the period of such adjournment.

(2.) At the end of the period of adjournment the case shall again be called on, and if any such person does not satisfy the Magistrate that he has obtained or endeavoured to obtain work, or if such person does not appear at such adjournment, the Magistrate may deal with him as in the next succeeding section mentioned.

(3.) It shall be lawful for the Magistrate to accept such evidence, whether strictly legal or not, of the fact that such person has obtained or has endeavoured to obtain work as the Magistrate thinks fit.

7. If any such person does not satisfy the Magistrate that he has obtained or endeavoured to obtain work, or if he does not appear at the time and place to which the proceedings have been adjourned, the Magistrate may order him to be taken and detained in a settlement as hereinafter in this Ordinance provided, for any period not less than three months or more than twelve months.

8. For the purposes of this Ordinance the Governor in Executive Council may by proclamation declare any area to be a settlement within the meaning of this Ordinance.

9.—(1.) The Governor in Executive Council may make regulations for the management of settlements, and may, but without limiting the general power of making regulations conferred by this section, make regulations for all or any of the following purposes:—

- (a.) For providing for the appointment and remuneration of officers of such settlements;
- (b.) For providing for the discipline of persons detained in any such settlements;
- (c.) For providing for the method of housing and rationing of such persons;
- (d.) For providing for the work to be performed by them, and for the awarding of remuneration to those behaving and working satisfactorily;
- (e.) For allowing of such persons being employed away from a settlement before the expiration of their period of detention therein, and for the providing for the times and conditions of such employment and of their return to the same or another settlement;
- (f.) For providing for the arrest of persons deserting from any such settlement, or employment.

(2.) All such regulations shall be published in the *Royal Gazette*.

10.—(1.) Any person detained in a settlement committing any breach of a regulation under this Ordinance is liable on conviction before a Magistrate to imprisonment with or without hard labour for any term not exceeding one month.

(2) At the end of any period of imprisonment awarded under this section, any such person shall be conveyed by a Warden or Constable and delivered to the person in charge of the settlement in which he was originally detained to complete the term of service there to which he was originally sentenced.

(3)—(a.) The Magistrate before whom any such person is convicted may, in lieu of ordering him to be imprisoned forthwith, direct that execution of the sentence of imprisonment be postponed for a period of three months.

(b.) If such person behaves during such period to the satisfaction of the officer in charge of the settlement, such officer shall so inform the Magistrate, and no further steps shall be taken to carry the sentence into execution.

(c.) If the officer in charge of the settlement reports that the person convicted has not behaved to his satisfaction, then the sentence of imprisonment shall be carried into execution.

11. Any person convicted before a Magistrate of being a habitual idler after detention in a settlement is liable to imprisonment with or without hard labour for any term not exceeding three months.

12. Every proclamation under this Ordinance shall be published in the *Royal Gazette*; and a production of a copy of the *Royal Gazette* containing any such proclamation shall be *prima facie* evidence in all Courts and for all purposes whatsoever of the due making and tenor of such proclamation.

13. The procedure in respect of offences under this Ordinance shall be that laid down in the Summary Conviction Offences (Procedure) Ordinance, (No. 1).

14. This Ordinance shall commence on a day to be fixed by the Governor by Proclamation in the *Royal Gazette*.

Passed in Council this Nineteenth day of April in the year of Our Lord one thousand nine hundred and eighteen.

J. M. FARFAN,
Acting Clerk of the Council.

●
HABITUAL IDLERS ORDINANCE.
Amendment.

TRINIDAD AND TOBAGO.

No. 11.—1919.

I ASSENT,

[L.S.]

W. M. GORDON,
Acting Governor.

19th May, 1919.

AN ORDINANCE to amend the Habitual Idlers' Ordinance, 1918.

[19th May, 1919.]

BE it enacted by the Governor of Trinidad and Tobago with the advice and consent of the Legislative Council thereof as follows :—

1. This Ordinance may be cited as the Habitual Idlers' (Amendment) Ordinance, 1919.

2. Section 2 of the Habitual Idlers' Ordinance 1918 is amended by striking out the definition of "Habitually abstains from work."

3. The following shall be read as sub-section (3) of Section 9 of the Habitual Idlers' Ordinance, 1918 ;

(3.) All such regulations shall be subject to disallowance by His Majesty.

Passed in Council this Second day of May, in the year of Our Lord one thousand nine hundred and nineteen.

J. M. FARFAN,
Acting Clerk of the Council.

METEOROLOGY.

RAINFALL RETURN.—APRIL TO JUNE, 1919.

Stations.	April.	May.	June.	January to June, 1919.	January to June, 1918.
<i>North-west District.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>
St. Clair—Royal Botanic Gardens ..	1'67	3'50	6'78	14'35	10'08
Port-of-Spain—Colonial Hospital ..	2'08	1'22	7'50	12'09	12'14
„ Royal Gaol ..	2'03	2'80	7'00	15'23	17'12
„ Constabulary Headquarters ..	1'43	3'12	7'80	14'55	12'17
St. Ann's—Reservoir ..	0'68	3'97	8'35	15'53	21'08
Maraval—	52	3'70	6'67	13'27	18'24
„ Constabulary Station ..	73	5'01	7'71	10'71	19'04
Diego Martin—Constabulary Station ..	1'61	5'94	7'58	19'89	26'46
„ Waterworks ..	1'82	4'92	6'77	17'17	20'55
„ River estate ..	1'78	4'62	6'88	16'48	20'99
Fort George Signal Station ..	1'49	3'11	6'87	14'39	15'75
North Post ..	1'77	1'02	4'36	13'19	18'90
Chicnago Constabulary Station ..	1'12	4'76	5'40	17'14	20'21
Carrera Island Convict Depot ..	45	1'99	2'88	6'50	5'97
Chacachacare Lighthouse ..	1'07	3'44	6'38	13'12	19'52
<i>Santa Cruz—Maracas District.</i>					
Santa Cruz—Constabulary Station ..	1'93	4'26	8'80	19'74	21'63
St. Joseph—Government Farm ..	1'57	2'92	10'22	16'70	15'40
„ Constabulary Station ..	nil	1'42	6'42	8'93	10'97
Tunapuna—St. Augustine estate ..	1'02	2'74	10'24	15'68	14'75
Maracas—Government School ..	1'74	3'61	11'01	19'80	22'46
„ Ortinola estate ..	1'33	3'78	8'41	16'91	19'82
„ San José estate ..	2'06	3'71	10'65	19'16	18'83
Caura—Wardour estate ..	1'57	3'06	8'03	15'01	18'68
<i>West Central District.</i>					
Caroni—Frederick estate ..	2'88	7'31	8'24	23'57	20'55
Chaguana—Constabulary Station ..	2'22	4'89	8'93	18'32	15'61
„ Woodford Lodge estate ..	2'12	5'37	9'16	19'23	15'77
Carapichaima—Waterloo estate ..	2'02	4'03	11'87	20'07	20'47
„ McBean Cacao estate ..	1'77	5'07	9'44	19'32	17'27
„ Friendship Hall estate ..	1'72	4'89	9'29	18'87	No record
Couva—Exchange estate ..	1'29	4'26	8'56	16'86	11'75
„ Brechin Castle estate ..	98	5'05	8'23	18'10	17'41
„ Perseverance ..	...	...	...	...	12'40
„ Camden ..	30	...	...	...	8'30
„ Milton ..	1'00	4'74	11'68	19'72	17'98
„ Spring ..	1'37	5'24	9'41	19'54	23'11
„ Constabulary Station ..	1'61	6'01	9'55	20'34	13'55
„ Esperanza estate ..	38	3'30	8'42	15'63	15'80
<i>Montserrat District.</i>					
Brasso-Piedra Mamoral estate ..	2'53	9'71	11'98	27'92	33'05
„ La Mariana estate ..	2'50	9'80	12'92	28'75	29'63
Montserrat—Constabulary Station ..	1'57	5'46	11'73	23'11	21'40
Brasso—La Vega estate ..	2'44	7'93	12'34	25'91	29'10
<i>Arima District.</i>					
Arima—Warden's Office ..	1'33	4'49	12'92	20'50	24'55
„ Torrecilla estate ..	2'14	5'30	15'50	25'47	29'55
„ Verdant Vale estate ..	1'37	4'88	14'13	24'50	27'21
San Rafael—Constabulary Station ..	2'54	10'00	14'11	31'44	33'21
Guanapo—Talparo estate ..	2'87	8'43	12'42	29'15	31'25
„ San José Estate ..	2'02	9'58	13'17	29'96	30'23
Tamana—Sta. Marta estate ..	2'67	11'98	15'20	35'84	43'82
„ La Carona estate ..	2'76	11'01	11'83	31'93	37'61
<i>San Fernando & Princes Town District.</i>					
Claxton's Bay—Forros Park estate ..	81	3'50	8'55	14'76	18'07
Pointe à Pierre—Bonne Aventure estate ..	1'19	3'22	9'46	15'21	23'33
„ Concord estate ..	2'05	3'54	8'67	16'83	18'33
„ Plein Palais estate ..	95	5'06	10'52	19'61	23'11
Naparima—Pieton estate ..	43	2'29	8'17	14'51	22'55
„ Usino St. Madelaine estate ..	96	...	...	...	18'40
„ La Fortunée estate ..	72	2'41	...	...	...
„ Tarouba estate ..	29	3'96	8'96	11'84	21'96
„ Union Hall estate ..	...	...	...	...	...

RAINFALL RETURN—APRIL TO JUNE, 1919.—CONTINUED.

Stations.	April.	May.	June.	January to June, 1919.	January to June, 1918.
<i>Sun Fernando and Princes Town District.—(Contd.)</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>
Napaima—Palmiste estate ...	77	5.27	10.77	20.53	23.73
" Lewisville House ...	80	5.33	11.41	22.48	21.90
" Hermitage estate ...	88	3.34	8.78	15.47	21.57
" Petit Morne estate ...	35	...	...	...	17.80
Princes Town—Craignish estate ...	1.07	5.49	11.71	21.72	24.76
" Cedar Hill estate ...	78	5.78	10.93	21.09	...
" Williamsville estate ...	3.25	3.94	10.40	21.56	21.54
" Esmeralda estate ...	5.63	13.76	...	...	24.74
" New Grant estate ...	2.11	6.91	12.41	15.20	34.78
" Constabulary Station ...	43	4.37	8.66	16.42	20.44
" Hindustan estate ...	1.37	6.35	9.95	21.33	25.87
" La Retraite estate ...	2.78	6.53	15.76	30.56	40.13
" Malgretoute estate ...	80	1.88	11.17	16.33	...
Friendship & Ben Lomond estates ...	...	...	...	...	...
Los Naranjos estate ...	1.46	7.07	...	...	25.64
Poole—El Rosario estate ...	1.38	5.73	12.61	23.61	35.24
<i>South-west District.</i>					
Oropuche—Constabulary Station ...	67	1.64	3.37	8.21	25.69
" Pluck estate ...	1.29	5.92	8.61	19.94	24.19
Siparia—Constabulary Station ...	25	4.75	5.85	13.33	27.98
" Alta Gracia estate ...	46	5.10	10.96	21.48	20.14
Guapo—Adventure estate ...	1.14	4.32	6.58	14.77	22.78
Point Fortin—Constabulary Station ...	1.09	8.26	7.74	20.36	24.43
Erin—La Resource estate ...	...	2.55	7.34	...	22.86
La Union estate ...	1.11	3.35	9.73	16.92	24.06
Industry estate ...	1.07	3.32	9.02	15.59	25.00
Cedros—La Retraite estate ...	1.31	7.09	9.38	21.76	28.12
" Beaulieu estate ...	76	6.56	10.11	19.66	19.71
" Perseverance estate ...	1.07	6.50	8.70	18.92	...
" St. Marie estate ...	67	6.88	8.41	19.38	24.69
" Constabulary Station ...	69	6.10	9.24	20.93	22.77
" St. Quintin estate ...	52	6.66	8.55	18.00	23.91
Icacos—Constance estate ...	76	...	...	...	56.38
Irois—Government School ...	79	4.16	10.46	19.68	21.46
<i>South Coast.</i>					
Moruga—Constabulary Station ...	2.36	8.68	8.95	22.96	23.96
<i>East Coast.</i>					
Matura—La Juanita estate ...	2.26	11.60	12.56	31.01	41.03
Manzanilla—Constabulary Station ...	2.59	8.48	11.91	28.11	38.61
" Indrasan estate ...	2.19	4.57	9.23	20.61	37.44
Sangre Grande—New Lands estate ...	...	9.20	10.74	...	30.62
" Evasdale estate ...	4.04	10.11	12.91	33.71	38.37
" Grosvenor estate ...	3.70	10.35	11.87	32.15	39.72
" San Hilario estate ...	2.82	8.78	10.07	27.34	30.59
" San Francisco estate ...	3.95	10.68	13.05	33.15	11.67
Mayaro—Constabulary Station ...	98	7.05	10.04	21.78	36.60
<i>North Coast.</i>					
Blanchisseuse—Constabulary Station ...	97	6.87	9.78	24.41	30.24
Grande Rivière—Mon Plaisir estate ...	2.18	12.52	9.74	30.17	...
Toco—Aragua House ...	55	9.46	8.03	21.73	35.34
" Constabulary Station ...	54	9.48	7.46	20.69	31.20
Point Galera—Light House ...	...	...	...	...	26.81
<i>Tobago.</i>					
Tobago—Hermitage estate ...	2.25	8.68	10.68	28.38	34.51
" King's Bay ...	3.58	9.45	8.83	27.70	31.87
" Roxburgh ...	4.82	8.64	8.44	27.49	...
" Lure estate ...	...	...	...	...	31.21
" Botanic Station ...	2.90	6.26	7.38	18.28	26.06
" Government Farm ...	1.88	5.31	5.10	13.57	19.00
" Lowlands estate	21.82
" Friendship ...	96	5.36	5.87	14.71	22.70
" Riversdale ...	2.59	6.08	22.19
" Bon Accord	17.95

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Part 3.]

1919.

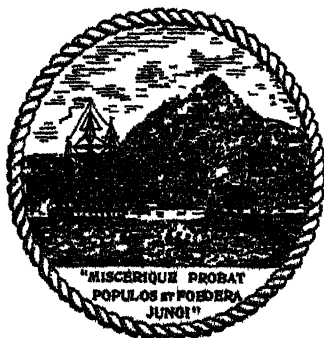
[Vol. XXVIII.]

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE TRINIDAD & TOBAGO.

Issued by the Department and Board of Agriculture



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Editor:

W. G. Freeman.

TRINIDAD:

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DEPARTMENT OF AGRICULTURE.

Agricultural Credit Societies

under Ordinance No. 80, 1915.

Registrar.....W. G. FREEMAN, Director of Agriculture.*Inspector*.....JOS. E. SEHEULT.

REGISTERED SOCIETIES.

<i>Trinidad</i>				<i>Date of Registration.</i>	
Diego Martin	...	...	...	October	12, 1916.
Lothians	...	...	...	April	4, 1919.
Malgretout	...	...	...	April	30, 1919.
Petit Morne	...	...	...	April	30, 1919.
Union Hall	...	...	...	April	30, 1919.
Malgretout East Indian	...	...	..	May	26, 1919.
Picton	...	...	...	May	30, 1919.
Petit Morne (Palmyra)	...	...	...	June	13, 1919.
Tarouba (Ne Plus Ultra)	...	...	...	June	13, 1919.
Union-Marabella	...	...	...	July	10, 1919.
Harmony Hall	...	...	...	July	10, 1919.
Williamsville East Indian	...	...	...	July	10, 1919.
Indian Walk	...	...	...	August	19, 1919.
Williamsville, West Indian	...	...	...	September	11, 1919.
Plein Palais	...	...	...	November	9, 1919.
Lengua	...	...	...	November	9, 1919.
<i>Tobago.</i>					
Pembroke	...	...	...	June	18, 1917.
Scarborough	...	..	...	April	11, 1918.
Delaforde	...	...	...	August	26, 1918.
Mason Hall	...	...	...	December	16, 1918.
Moriah	...	...	...	December	16, 1918.
Charlottetown	February	4, 1919.

Plant Protection Ordinance.*Chief Inspector* (Acting).....W. E. BROADWAY.

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	H. MEADEN.
	L. A. BRUNTON.

Assistant Inspectors.....

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	J. BLACKMAN.
	R. H. LEACOCK
	ALFRED H. PENA (Tempy).

Reference Library.

THIS Library can be consulted at the Head Office of the Department, St. Clair Experiment Station. It contains standard works on General Agriculture, Horticulture, Botany, etc., and books and periodicals dealing with Cacao, Sugar, Coconuts, Rubber, Cotton, Corn, Fruit, Tobacco, and other crops.

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<i>Laboratory and Field Assistant</i>	W. BUTHN.

* On leave for a year from December, 1918.

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Department of Agriculture.

GOVERNMENT STUD ANIMALS.

THE following are the arrangements for November and December with regard to Stud animals of the Government Farms in Trinidad and Tobago.

Stallions.

<i>Name.</i>	<i>Class.</i>	<i>Where standing for Service.</i>	<i>Fee.</i>	<i>Groom's Fee.</i>
QUICKMATCH.	Thorough-bred	...Govt. Farm Trinidad...	\$ 10.00	60c.
SIR HOBBS...	Thor'gh-bred Hackney.	Govt. Farm "	5.00	60c.
SIR HORACE...	Half-bred Hackney	Govt. Farm "	5.00	60c.
RILLINGTON SPARTAN...	Cleveland Bay.	Govt. Farm "	5.00	60c.
MARAT	...Thorough-bred	...Roxburgh, Tobago	5.00	60c.

Jack Donkeys.

Monarch	...American Donkey	...Govt. Farm, Trinidad...	\$ 5.00	60c.
President	... Do. do.	...Govt. Farm, Tobago...	5.00	60c.
Barbados Joe	...	...Govt. Farm, Trinidad...	1.20	60c.

Bulls.

A.—AT GOVERNMENT FARMS.

TRINIDAD.			TOBAGO.	
<i>Class.</i>		<i>Fee.</i>	<i>Class.</i>	<i>Fee.</i>
2 Pure-bred Zebu	...	\$ 1.20c.	1 Pure-bred Zebu	...\$1.00
1 " Jersey	...	2.40c.	1 Half-bred Guernsey	... 1.00
3 Half-bred Red Poll	...	1.20c.		
1 Half-bred Holstein	...	1.20c.		
1 Half-bred Shorthorn	...	1.20c.		

B.—AT PUBLIC PASTURES OR ESTATES.

<i>Place.</i>	<i>Class.</i>
Queen's Park Savannah	1 Half-bred Shorthorn; 1 Half-bred Holstein.
Mucurapo Pasture	1 Half-bred Shorthorn; 1 Half-bred Guernsey.
St. Clair Expt. Station	1 Half-bred Holstein.
St. Augustine Estate	2 Half-bred Holstein; 1 Half-bred Guernsey.
River Estate	1 Half-bred Zebu;
San Fernando	1 Pure-bred Holstein; 1 Half-bred Jersey.
Harmony Hall Estate	1 Pure-bred Shorthorn.
Arima	1 Half-bred Jersey.
Tobago, Friendship Est.	1 Half-bred Holstein.

Pigs.

AT GOVERNMENT FARM, TRINIDAD.

White Yorkshire, Poland China, Berkshire, Tamworth \$1.00, and Attendant's Fee 25c.

AT GOVERNMENT FARM, TOBAGO.

Berkshire Fee 50c.
 Berkshire ... AT ST. CLAIR EXPERIMENT STATION.
 ... \$1.00 and Attendant's Fee 25c.

POULTRY.

GOVERNMENT FARM, TRINIDAD.

Eggs of Barred Plymouth Rocks, Rhode Island Reds,
 White Leghorns \$1.00 per doz.
 Great Kind Pigeons 40c. and 60c. per pair.

GOVERNMENT FARM, TOBAGO.

Eggs of Plymouth Rocks, Black Minorcas, Rhode Island Reds 48c. per doz.
 Also Cocks and Pullets of Plymouth Rocks and Rhode Island Reds

Department of Agriculture.

NURSERY STOCK.

Cacao, Limes and any other plants required in large quantities for delivery for early planting in 1920 should be ordered now; address letters to the Superintendent, St. Clair Experiment Station, or to the Officer in Charge Botanic Station, Tobago.

Special quotations at St. Clair for Cacao, Coffee and Limes grown from selected seeds are as follows:—

Plants purchased in lots of 1 to 1,000 plants	} Delivered at Nurseries
8 cents per plant.	
Plants purchased in lots of several thousands	} uncrcated.
2½ cents per plant.	
Plants purchased in lots up to 100 at 4 cents per plant.	} Delivered at Railway Station, Port-of-Spain or Queen's Wharf, securely packed in open crates.
Plants purchased in lots up to 1,000 at \$3.50 per 100.	
Plants purchased in lots of several thousands at \$88.00 per 1,000.	

Tobago prices on application at the Botanic Station, Scarborough.
 Budded Avocados select varieties at 12½ cents, Budded Oranges at 24 cents and Grafted Mangos at 24 cents should also be booked at once.
 Budded Cacao 12 cents each or in lots of over 100 at 8 cents.
 Limes from beds 1½ cents per plant for lots over 100.

A select stock is also kept of other fruit, ornamental and flowering trees, palms, etc., a list of which can be obtained on application. Large orders must be booked six months previous to the date when the plants are required as large supplies are not kept on hand for casual demands.

Board of Agriculture.

SPRAYING CACAO, &c.

From September to November is the time for spraying cacao trees for the prevention of thrips and black rot; and early in the dry season for the Algal disease, die back, and cacao beetles.

The Board of Agriculture has on hand a supply of bluestone, which is sold to planters at 12 cents per pound, also nicotine sulphate the best insecticide for thrips, which is sold at \$10.70 per gallon.

Men will be provided to superintend any spraying work which estates may wish to have done.

Further information in regard to cost of spraying, etc., and applications for bluestone and nicotine sulphate should be made to

THE SECRETARY,
 Board of Agriculture,
 Port-of-Spain.

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BULLETIN
OF THE
DEPARTMENT OF AGRICULTURE
Trinidad and Tobago.

PART 3.]

1919.

[VOL. XVIII.]

FRUIT.

THE AVOCADO IN TRINIDAD AND TOBAGO.

By W. G. FREEMAN, B.Sc., A.R.C.S., F.L.S.,
Director of Agriculture, Government Botanist.

THE Avocado (*Persea gratissima*) is one of the most important of the fruits which have become widely distributed since the discovery of the New World. Amongst the other tropical fruits which are natives of the New World may be mentioned the guava, custard apple, maimmee apple, cashew, sapodilla, and the papaw. There is some doubt as to the original distribution of the avocado, but the general opinion is that it is native to tropical America from Mexico to Peru and is probably not truly wild in the West Indies, although introduced into the islands at an early date and now naturalized in them. The earliest references, accessible to me in the original, to the tree in the West Indies are given below. Both refer to Jamaica. It will be noted that one author speaks of the avocado as being planted, whilst the other specifically states that it was introduced from the Continent.

EARLY HISTORY IN THE WEST INDIES.

Sir Hans Sloane, M.D., F.R.S., who visited Madeira, Barbados, Nevis, St. Kitts, and Jamaica in 1689, as physician to the Duke of Albemarle, Governor of Jamaica, published in 1707 to 1725 after his return to England, his well known *History of Jamaica* in which (Vol. II. p. 183) he gives the following interesting description of the Avocado.

"The Albecato pear-tree, Hisp. Abacado, seu, Avocado. This tree has a Trunc as thick as one's Middle, with a light brown or grey ash-coloured Bark, having very deep Furrows or Sulci in it, rising to twenty or thirty Foot high; the Ends of the Branches have a great many Leaves, standing without any Order on yellowish half Inch long Footstalks, they are three Inches long, and one and a half broad in the Middle, where broadest, very smooth and of a deep green colour, with an Eye of yellow in it, having one Rib in the Middle and several transverse ones branch'd from it. Among the Leaves come out a short half Inch long Stalk, to which are fasten'd by short Petioli from near the Bottom, Flowers of a yellowish green Colour, to which follows a Fruit shaped like a Pear, as big as one's two Fists, greenish on the outside, having a smooth Skin and a Pulp under it of an Inch in Thickness, which is green, soft, almost insipid to the Taste, and very nourishing. Within this lies a naked great Kernel bigger than a Walnut, having many Tubercles and Sulci on its

surface, divisible into two great Lobes, between which lies the young Sprout or Germen.

"It is planted and grows everywhere in this Island.

"This is accounted one of the wholesomest Fruits of these Countries, not only by Way of Disert, being eat with Juice of Lemons and Sugar to give it a Piquancy, but likewise for supporting Life itself. It is useful not only on these Accounts to Men, but likewise to all Manner of Beasts.

"It is reckon'd a great Incentive to Venery, and so says *Scaliger*.

"*Hawks ap. Hakl. p. 3. p. 464.* found this Tree about *Mexico*.

"There (in the way between *Panuco* and *Mexico*) groweth a Fruit which the Spaniards call *Avocottes*, it is proportion'd like an Egg, and as black as Coal, having a Stone in it, and it is an excellent good Fruit. *Hortop. ap. Hakl. p. 3. p. 492.*

"*Hughes, p. 40.* tells us that this Fruit nourishes, strengthens, and is Venereal; and that it is eaten with Vinegar and Pepper.

"*Clusius* describes this Tree with a black Fruit, and 'tis purplish when ripe; he described the Fruit by Hearsay, the rest well, only it has a pentapetalous Flower.

"The Leaves dry, powder'd and strew'd on Wounds, cure Hæmorrhages. *Jonst.*

"The Fruit is eat with Salt and Plantain roasted, and is fit to make a Meal of, at *Campeche*, *Cartagena*, *Caraccas* and *Jamaica*, *Dampier*.

"I believe the Synonymous Names in my Catalogue, p. 185, to belong to this Tree notwithstanding what is said by *Dr. Plukenet*, p. 18 of his *Mantissa Hernandez. fol. 69.* describes it with many Kernels which may be a Variety."

In 1756 another physician, Dr. Patrick Browne published *The Civil and Natural History of Jamaica* with the following note on the Avocado:

"The *Avocato*, or Alligator pear tree.

"This tree grows commonly to the size of our largest apple trees in *Europe*, and spreads pretty wide at the top. The branches are very succulent and soft; the leaves oblong and viny, and the fruit of the form of a pear; but the pulp is covered with a tough skiny coat, and contains a large rugged seed, which is wrapped up in one or two thin membranous covers. The fruit of this tree is one of those that is held in the highest esteem, among all sorts of people in those colonies; the pulp is of a pretty firm consistence, and has a delicate rich flavour; it gains upon the palate of most people and becomes soon agreeable even to those who cannot like it at first; but is so rich and mild, that most people make use of some spice or pungent substance to give it a poignancy; and for this purpose, some make use of wine, some of sugar, some of lime juice, but most of pepper and salt. Most sorts of creatures are observed to feed on this fruit with pleasure; and it seems equally agreeable to the horse, the dog, the cow, and the cat, as well as to all sorts of birds; and, when plenty, makes a great part of the delicacies of the negroes.

"The tree requires some care, a rich soil, and a warm situation, to raise it to perfection. It was first introduced there from the continent."

COMMON NAMES.

It will be noticed that in these old accounts there was already a considerable variation in the spelling of the name of the plant. Since those days more names have been coined, and Dr. J. N. Rose in *Notes on the useful Plants of Mexico* gives as many as nine. "Aguacate, Ahuacate chico, Ahuacate grande, avocado, avocado pear, Alligator pear, midshipman's butter, vegetable butter, vegetable marrow." Most of these are known here, and to them we can add "Zabaca." A desire has already been expressed in other countries to adopt a uniform name and in particular to drop the misnomer "pear." In the United States, the Department of Agriculture, the American Pomological Society, the California Avocado Association, and other bodies have decided to use only the name avocado and their example is recommended here. (1)

PRESENT DISTRIBUTION.

From its original home the avocado has been introduced not only into the West Indies, but into many other tropical and sub-tropical countries. Aublet in his *Histoire des Plantes de la Guiane Française*, published in 1775, records its cultivation in Cayenne and states that in 1750 seeds were taken from Brazil to Bourbon and that a tree raised from one of these fruited in 1758.

"The tree grows and fruits well in Southern India, Ceylon and also in parts of the Straits and Federated Malay States, but is not so widely cultivated as it might be" (J. Lansbourne *Jr. Bull. Fed. Malay States* ii, 1914. 259.) In the Philippines the early introduction by the Spaniards were not very successful but attention is being again given to the plant. In Tropical Australia, e.g. Queensland the avocado thrives. In Africa it is well known in Natal and in the Congo; recently Egypt has taken up its cultivation. our Department of Agriculture having been asked to supply seeds in large quantities. (2) In Madeira and the Canary Islands avocados are cultivated on a commercial scale and exported to England. The fruits are usually very small compared with the better kinds here but they sell to a limited extent at prices ranging from about 9d. to 1s. 3d. (pre war). In Hawaii great care and attention is being given to the avocado and some 65 varieties were under cultivation at the Agricultural Experiment Station in 1911 ("The Avocado in Hawaii" *Bull. 25 Hawaii Ag. Exp. Station*.) It is in Florida and Southern California that the greatest interest is being displayed in avocado cultivation, evidence of which is afforded by the existence of the California Avocado Association. In a paper read at the fourth semi-annual meeting of the Association in October 1916 a description was given of 140 named varieties under cultivation and trial in California alone. (3)

CULTIVATION IN THE WEST INDIES.

Although so long cultivated in the West Indies but little attention appears to have been given until quite recently to the selection, introduction and propagation of good varieties of avocados.

(1.) The Plate "Anthracnose of Alligator Pear" was prepared previously to this decision.

(2.) See R. O. Williams "Packing Avocado Seeds for Transport" *Bull. Dept. Agr. Trinidad & Tobago*. XVII. 1918. 56. The best results were obtained with seeds in charcoal.

(3) I. J. Condit "History of the Avocado and its varieties in California with a check list of all named varieties." *California Monthly Bulletin* VI. 1917 1-21.

It is well known that the avocado is extremely variable and experience here as in other countries proves that propagation by seed is an unreliable means of securing good kinds. In many cases no effort at selection was made but any seeds sown, with the result that we find good, indifferent and bad kinds growing together indiscriminately.

There are two generally applicable methods of improving fruit bearing trees, seed selection and propagation by budding, grafting, etc. Seed selection entails choosing seeds from trees bearing the best kinds of fruit and characterised also by vegetative vigour and high productiveness. From a large number of plants so produced it is probable that a few may be better than the parent, others as good, and the rest inferior. The relative numbers in each group depend on various factors which vary with different kinds of plants. Some plants breed fairly true from seed, others are very variable. For the person wishing to establish an orchard of good trees the method has obvious disadvantages if the plant he is cultivating is one which does not breed true, and especially, as in the case of the avocado, if it takes several years to come into bearing. He selects his seeds, brings at considerable expense, his plants to the bearing stage, only to find that he has a very mixed assemblage of good, bad, and indifferent kinds.

The avocado is such a variable plant and definitely known examples show the great variation in fruits all raised from the seeds of a single tree.

Fig 1. Shows an instance of an undesirable large seeded fruit produced by a seedling of a tree bearing large fruits with very small seeds.

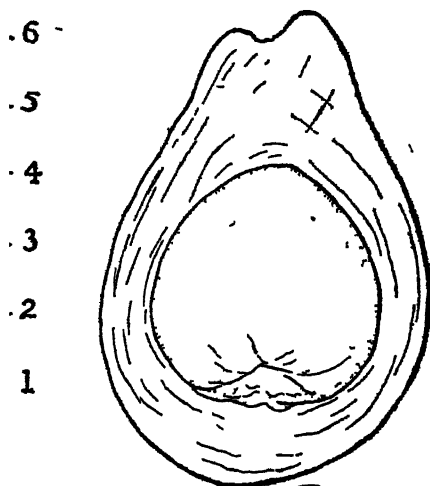


FIG. 1.—A LARGE SEEDED AVOCADO

A seedling from a tree bearing a large fruit with a very small seed

By making use of the second method of propagation—budding or grafting—we can get over this difficulty provided we have a good variety to bud or graft from. It is necessary to emphasize this point

because although it has been explained over and over again, so many people apparently believe that the operation of budding or grafting in itself improves the character of the fruit. This is of course an absolute fallacy. It is just as easy and certain to propagate bad kinds of fruits by grafting and budding as good kinds. Thus with the mango the common, stringy, mango vert can be grafted on to a Julie mango stock and the result will be a grafted tree bearing common mangos. In grafting or budding you do not improve the fruit but you do ensure getting the particular variety which you have selected as desirable to reproduce. Whether it be good or bad depends on your selection.

Now I have already shown that the avocado was very early introduced into the West Indies. It has probably been cultivated in these islands for the last two hundred years or so, and until within quite recent times has been propagated exclusively by seed. The result is that we have enormous numbers of trees here, in Barbados, Grenada, St. Vincent, etc., of very variable characteristics; some very good, many of medium quality and a large number of a poor type. It is reasonable to suppose that the tendency has been to take care of the better kinds, and when trees had to be cut out, to get rid of those which were inferior. In other words we have been practising for a couple of centuries the preliminary work of seed selection, raising large numbers of seedlings, but without proceeding to the next stage of fixing the good types which have arisen. The position is exactly the same as it was here with the orange up to about twenty years ago, when plants were raised only from seed, with the result that there was no certainty of securing any definite variety. Now by the use of budded plants any one can establish an orchard of King, Jaffa, Washington Navel or any other chosen variety with certainty of the plants coming true to type.

SELECTION OF GOOD VARIETIES.

In order to obtain an example of the variability which is to be found amongst avocados, raised without any care in selection, I examined average fruits of fourteen trees growing scattered through the cacao of River Estate. There has been no definite planting of avocados on the estate and most of the trees have presumably grown up casually in cacao contracts, etc. Three fruits from each tree were weighed together and the average weight of a single fruit obtained. The lowest was 7 oz. and the highest 1 lb. 12 oz. The average of the whole fourteen trees was 14 oz. per fruit.

The weight of the stone in a single fruit varied from 1½ oz. to 4½ oz. The comparative size of the stone is however best shown by giving it as a percentage of the total weight of the fruit. When worked out on this basis the figures show a range of from 14·6 to 42·5 per cent., *i.e.* the stone varies in different types from about one-seventh to nearly one-half the total weight of the fruit. The average weight of the stone was 29·5 per cent. of the whole fruit.

From the figures in the Table below it will be seen that one tree at River (No. 14) stands out markedly above the others. The differences may be summarized thus.

	<i>Weight of Fruit</i>	<i>Stone per cent.</i>
Average (of 14 trees)	... 14 oz.	29·5
Worst tree	... 7 oz. (No. 18)	42·5 (No. 8)
Best tree	... 1 lb. 12 oz. (No. 14)	14·6 (No. 14)

Tree No 14 has both the largest fruit, and relatively the smallest stone. The fruit is also of very good flavour. This tree has therefore been selected from amongst all those at River as the one most worthy of propagation and budded plants of it are sold by the Department of Agriculture under the name of the 'River avocado'.

TABLE SHOWING VARIATION IN WEIGHT OF FRUIT AND PROPORTION OF STONE IN SOME TRINIDAD AVOCADOS

No	Source	Weight single fruit (1)		Percentage—Single Fruit by Weight		Remarks
		lb	oz	Stone	Flesh and Rind	
1	River Estate		14	35	65	
2			7	30	70	
3			10	40	60	
4		1	1	24.1	75.9	
5			13	37.5	62.5	
6		1	0	27.5	72.5	
			13	16.6	83.4	See Fig
8		1	0	42.5	57.5	See Fig
9		1	5	29.7	70.3	
10			9	29.1	70.9	
11			11	37.2	62.8	See Fig
12			11	50.0	50.0	See Fig
13				51.5	48.5	See Fig 2
14		1	12	14.6	55.4	Selected by the 'River
15	Mrs. Stollmeyer					Avocado - See fig 4
	Diego Martin	1	0	22.1	77.9	
16		1	3	10.6	89.4	
17			11	20.4	79.6	
18		1	2	27.5	72.5	
19	Garden Govt					
	Botanist R B G	1	4	21.8	78.2	Purple Avocado
20	"	1	7	15.4	84.6	Selected by the St Ann's Avocado - See fig 4

See Fig 1

See Fig 2

See Fig 1

See Fig 2

See Fig 1

See Fig 2

See Fig 1

See Fig 2

See Fig 1

See Fig 2

See Fig 1

See Fig 2

See Fig 1

See Fig 2

(1) Average of three fruits

- 6

- 5

- 4

- 3

- 2

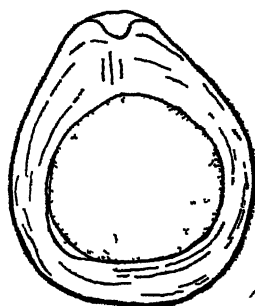
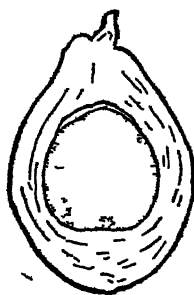


FIG 2—POOR KINDS OF AVOCADOS

On the left No 13 of the table above

Weight of fruit only 7 oz with 31.8 per cent of stone

On the right No 8. Weight of fruit 1 lb of which no less than 12.5 per cent is stone. The edible pulp of No 8 at the sides is but little over half an inch in thickness

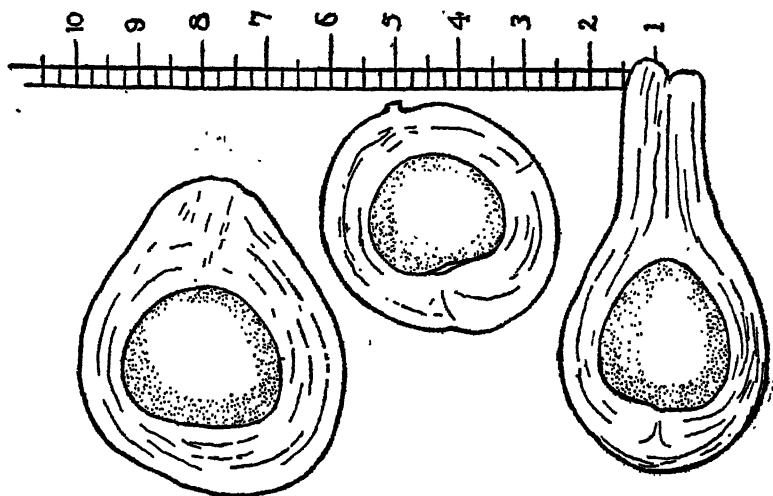


FIG. 3.—MEDIUM KINDS OF AVOCADOS.

On the left No. 11 of the table on p. 118.

Weight of fruit 15 oz. of which stone 27·2 per cent.

In centre No. 12. Weight 11 oz. 25 per cent. stone.

On left a bottle-necked variety, No. 7.

Weight 13 oz. of which 16·5 per cent. stone.

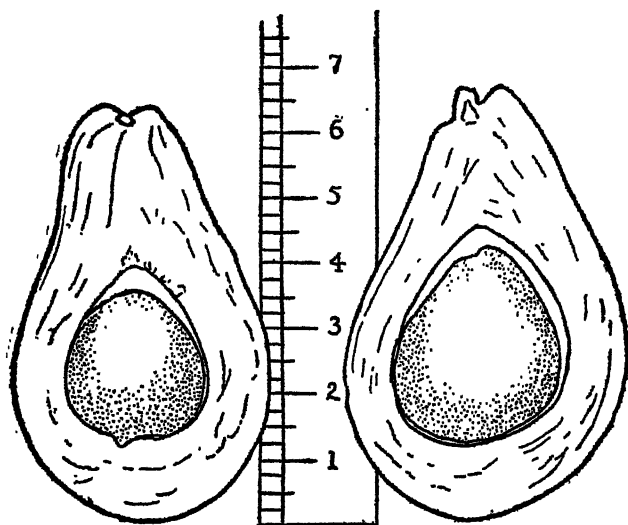


FIG. 4.—GOOD KINDS OF AVOCADOS.

On the left the "St. Ann's" Avocado. No. 20 table p. 118.

Weight 1 lb. 7 oz. with stone 18·4 per cent.

On the right the "River" Avocado. No. 14.

Weight 1 lb. 12 oz. and stone only 14·6 per cent.

These are the two Avocados now distributed by the Department as budded plants.

This example from River will serve to illustrate the origin of named varieties, here and in other countries, namely by the selection of the best of a large number of seedlings. Then having found the desirable kind, fix it by budding. The next step at River will be to cut down the poor trees, wait until they throw new shoots from the cut trunk, as they do very readily, and then bud on these from the selected trees. The poor trees will thus be converted into good varieties. One hundred and fifty budded plants have also been put in at River estate during the last two seasons.

A stage in the process of conversion from bad to good may be seen at the present time at Mrs. E. Stollmeyer's garden at Diego Martin. Of the trees originally there the good varieties have been selected and left. Of four bearing trees the weight of single fruits ranged from 14 oz. to 1 lb. 3 oz., the average being 1 lb. 1 oz. The poor trees have been cut back and budded, by Mr. Bailey, and at eighteen months after budding I was shown new trees, twelve to fifteen feet high, grown from the single bud.

Particulars of two other avocados growing in the garden of my official residence are also given in the table (Nos. 19 & 20). Their fruits weigh 1 lb. 4 oz. and 1 lb. 9 oz. respectively. Both are of excellent flavour. One (No. 19) is a purple thin skinned variety, whilst the other (No. 20) is a green kind with a thicker, harder skin, very firm flesh and a fixed stone. It appears a very good type not only for local use, but also for export, should such a trade develop later. This type has been selected for propagation and budded plants from this tree are distributed by the Department under the name of the "St. Ann's" Avocado.

It is not improbable that a seedless avocado may be obtained. Occasional seedless avocados have already been reported from the United States, and Honolulu, and should a tree or even a single branch of a tree be found bearing regularly seedless fruits the type could doubtless be fixed by budding. So far as I am aware this has not yet been achieved.

Another point to select for is early or late bearing. The avocado is a perishable fruit, and there is a tendency for the market to be glutted at one season, with correspondingly low prices, and a great scarcity at other times with comparatively high prices. Trees which bear earlier or later than usual are accordingly desirable, and watch should be kept for such trees and use made of them as sources of bud wood. It will be necessary to extend the observations over two or three years to ascertain that it is not an accidental variation in one season, and the observations are best made where several trees are growing together to eliminate effects of local conditions.

In addition to what may be termed the local types, there are a few introduced named varieties in the Colony. The "Pollock" (Fig. 5) a very large fruited avocado, which was introduced by Mr. Eugene André and thrives well at Port-of-Spain.

The "Trapp" a Mexican Variety which thrives in Florida was received from the United States Department of Agriculture in 1912.

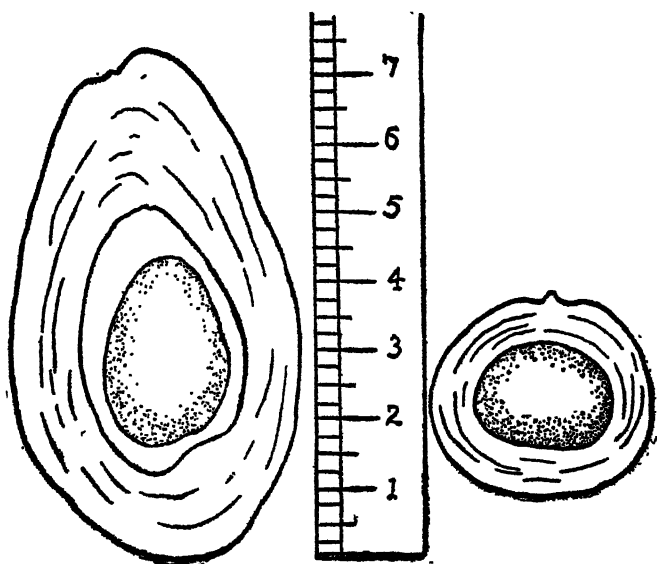


FIG. 5.—POLLOCK AVOCADO, on the left.
TRAPP AVOCADO, on the right.

PROPAGATION OF SELECTED KINDS.

To ensure the propagation of plants true to the selected type, the Department of Agriculture relies on budding which has been practised in the nursery at St. Clair Experiment Station for the last four years. The successful budding of the avocado in the West Indies was reported in Jamaica in the Annual Report of the Department of Agriculture for 1903-04, and by Mr. J. Jones at the Dominica Botanic Station in 1912. Difficulty was experienced at Dominica in budding plants in bamboo pots, and the raising of the stocks in nursery beds was recommended. Locally my attention was directed to the possibilities of budding the avocado by some results obtained by Mr. Bailey on old trees at Dr. Senior's Estate at Four Roads, Diego Martin. The work at St. Clair has been actively taken up by Mr. R. O. Williams who finds that budding of plants in bamboo pots is quite successful, provided young stocks are used. A description, by Mr. Williams, of the method employed follows (pages 125-8). I need not say more here excepting that local experience has proved that it is possible both to bud young plants, and to bud an old tree from a selected type and so convert a plant from a poor to a good kind.

CULTIVATION.

The Avocado needs no very special care in cultivation; at the same time it thrives locally much better in some districts and situations than in others. On the poor soil of parts of the Northern range in Trinidad it does exceedingly well and vigorous plants may be seen on the hillsides at the back of Port-of-Spain, and in the adjacent valleys of St. Ann's and

Diego Martin. The chief essential as regards soil appears to be that the drainage should be good. If budded plants are used, a distance of about twenty-five feet apart each way is recommended. Like most trees they respond to cultivation and thrive better if not allowed to be smothered in grass and bush. The best results will doubtless be obtained by growing leguminous catch crops on the ground between the young trees, preferably such as the sword bean (*Canavalia ensiformis*) which smother weeds, prevent soil wash, and yield a useful crop. If circumstances do not permit this, a space at least as wide as the spread of the branches should be kept clean around each tree.

Seedling avocados begin to bear in about six years, and budded plants usually about two years earlier.

The Avocado is often irregular in bearing, sometimes it flowers profusely and sets but little fruit. Indeed it has been suggested that the name avocado is derived from "Avocat" from the fact that as is sometimes the case with legal proceedings the fruit borne is by no means commensurate with the early promise.

LOCAL DEMAND.

The demand for avocados is greater than the local supply in normal years and there is a considerable importation of the fruit, principally from Grenada. In Port-of-Spain there is no difficulty in disposing of good class fruit at prices from about 3c. to 6c. each.

In the country districts the question of transport has to be taken into account. With all fruit, but particularly with the avocado, this means careful picking, handling and packing to ensure arrival at their destination in good condition. It is hoped that the formation of a Trinidad and Tobago Fruit Growers Association, may help in placing the avocado industry in a better position. In a season when avocados are plentiful one hears of persons who have quantities of fruit they do not know what to do with, and who will probably be disappointed at the results of casual efforts to find a market. Proper organisation is particularly necessary in dealing with perishable products.

FOOD VALUE OF THE AVOCADO.

The edible portion of the avocado varies from a little under one-half to over three-quarters of the weight of the whole fruit, according to the thickness of the rind and the relative size of the seed.

The following interesting table, showing the composition of the edible portion compared with other foodstuffs, is taken from *The Avocado in Hawaii*, Bulletin 25 of the Hawaii Agricultural Experiment Station.

PERCENTAGE COMPOSITION OF THE EDIBLE PORTION OF THE AVOCADO
AND OTHER FOODS.

Food Products.	Water.	Protein.	Fat.	Carbohydrates.		Ash.	Fuel value per lb.
				Nitro- gen free extract.	Crude fibre.		
Avocado (analysed at the Maine Station)	81.1	1.0	10.2	6.8		0.9	554
Avocado (analysed at the Florida Station)	72.8	2.2	17.3	4.4	1.0	1.4	854
Pickled ripe Olives ..	65.1	15.7	25.5	3.7		...	1,201
Pickled green Olives...	78.4	16.0	12.0	1.8		...	680
Apples ..	84.6	.4	.5	13.0	1.2	.3	290
Bananas ...	75.3	1.3	.6	21.0	1.0	.8	460
Pears ...	84.4	.6	.5	11.4	2.7	.4	295
Coconuts .	14.1	5.7	50.6	27.0	..	1.7	2,760
Chestnuts fresh ...	45.0	6.2	5.4	40.3	1.8	1.3	1,125
Potatoes ...	78.3	2.2	.1	18.0	.4	1.4	385
Wheat flour ..	12.0	11.4	1.0	74.8	.3	.5	1,630

As in most succulent fresh fruits there is a high percentage of water. Whilst however the food value of most fruits is due to the presence of sugars, and fat or oil occurs in them to only a small extent, the avocado is mainly valuable for its comparatively high fat content. Analyses of 28 different varieties made in California by M. E. Jaffa⁽¹⁾ showed a range of from 9.8 per cent. to 29.1 per cent. with an average of 20.1 per cent. "The only fruit comparable with the avocado in this respect is the olive."

LOW OIL CONTENT OF TRINIDAD GROWN FRUIT.

In looking up information on the oil contents of the Avocado I became interested in the series of analyses referred to above by Mr. E. Jaffa. From the results obtained in efforts to extract the oil, it seemed very improbable that Trinidad fruit contained anything approaching this amount of fat. As on further investigation I could find no records of the composition of Avocados grown in the wet tropics, but only from sub-tropical regions such as Florida and California, it seemed very desirable to obtain some accurate information of West Indian avocados. Accordingly I asked Mr. H. S. Shrewsbury, Acting Government Analyst if he would make some analyses. This he did and his results are appended (pages 184-5).

(1.) *The Avocado in California*, Part II. *Composition and Food Value*. Bulletin 254, Ag. Exp. Station, Univ. of California, 1915.

They show that avocados grown in Trinidad contain much less oil than in California and Florida. Thus of those analysed by Mr. Shrewsbury the richest in oil was the "River" 7.6 per cent. which is over 2 per cent. *below the minimum* of the California set.

In order to test whether the low oil content was a character of the local varieties only, or was to be found in introduced varieties as well, fruits of the "Trapp" avocado were included for analysis. The Trapp avocado at St. Clair is a budded plant presented by the United States Department of Agriculture and as Mr. Jaffa gives an analysis of the "Trapp" grown in California in his series, our plant afforded a good opportunity for comparing the oil content of fruits of budded plants of the same variety grown in Trinidad and California.

In California the Trapp is of low oil content, 9.80 *i.e.* the lowest of the set referred to above. The Trinidad fruits of the Trapp contain only 2.5 per cent. of oil! The comparative figures are given in detail on page 185.

Accounts have reached me of an excellent salad oil being prepared from the avocado. I have been unable to get any samples or to ascertain exactly how it is obtained. Mr. J. de Verteuil, Acting Assistant Director, prepared some at the Government Laboratory but it was most unpalatable.

AVOCADOS FOR EXPORT.

It is recorded that there was formerly a small, but steady export of avocados from the West Indies to New York, but that this has almost ceased, the reason given being the development of the industry in Florida and California.

In November, 1918 Prof. Carmody took with him to England two cases for the Hon. Arneaud de Boissière. They were kept in the vegetable room on the ship at 45 deg. F. and arrived in splendid condition. They were sold at the Army and Navy Stores. 3 dozen at 12/- per dozen, and 2 dozen at 10/- per dozen.

The report on them was very favourable, a point being made of their attractiveness in comparison with the ordinary Canary Islands fruit. (See *Bull. Dept. Agr.* XIII. 1914. 24). I have since received a request for more, but War conditions prevented any further consignments being made.

As however the Colony does not as yet produce enough avocados for its own requirements it is perhaps premature to think of an export trade. The important thing at present is to grow more of the good kinds for local consumption.

BUDDING THE AVOCADO.

By R. O. WILLIAMS,

Curator, Royal Botanic Gardens and St. Clair Experiment
Station, Trinidad.

THE varieties of Avocado (*Persea gratissima*) like the majority of cultivated fruits do not come true from seed, and therefore to keep a certain variety true to type it is necessary to use vegetative methods of propagation. The most successful and practical method so far adopted is budding.

Till recent years this on a large scale was thought to be very difficult and even at the present time some persons report that they are unable to bud the avocado successfully. In the annual report on the Hawaii Agricultural Experiment Station for 1912 it is stated "Thus the avocado which a few years ago was thought to be difficult or almost impossible of asexual propagation is yielding to many methods of propagation."

In the annual report for 1908-04 of the Jamaica Agricultural Department the method employed in budding Citrus is recommended as the one to be employed in this case, and in 1905 it is reported that avocados are budded successfully with scarcely the loss of a bud.

In a special pamphlet issued by the Lamoia Experiment Station Philippine Islands it is recommended to "use tender to mature but green, smooth, petioled budwood, cut the buds 3.5 to 4.5 centimeters long.⁽¹⁾ Age of stock at point of insertion of bud unimportant."

Reports from Florida state that there is no difficulty in getting the buds to grow after the union has been made.

As regards the budding of the Avocado at the St. Clair Experiment Station it was not until the year 1915 that it could really be said to have been successfully accomplished as before that date old stocks were used for budding upon and the percentage of successes were very small indeed. On December 15, 1915 budwood of a special Avocado was sent to the station and having no old stocks at that time in the nursery 12 buds were inserted on to very young ones of which 10 were successful. Since that date young stocks invariably have been used and only occasionally have old stocks been experimented with.

The following table gives a record of the results obtained when young stock viz: six weeks to four months old were used as compared with those of from 10 to 12 months. The percentage of successes when stocks were used ranged between 58 and 94, with an average on the total of 74, and when the older type of stock was used it fell to 17.1.

(1.) 2.5 centimeters = 1 inch.

Numerous other trials with old and young stocks during the past year or two confirm these figures.

Date of Budding.	Number budded.	Number of successes.		Failure.		United but bud dropped later.		Greatest height on January 1, 1919.	Average.
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.		
								Inches.	Inches.
November 8, 1918	47	41	87.2	3	6.4	3	6.4	9	3.78
" 13, 1918	133	94	70.7	32	24.0	7	5.3	7½	4.41
" 14, 1918	100	58	58	40	40.0	2	2.0	7½	1.55
" 23, 1918	27	22	81.5	5	18.5	...	...	2	36
December 4, 1918	50	47	94	3	6	...	...	1	buds just bursting
" 5, 1918	25	23	92	2	8	...	...	1	do.
Total ..	382	285	74.6	85	22.3	12	3.1		

Of the failures, 85 were rebudded with the following results :

December 30, 1918	35	23	65.7	12	34.3	..	..	1½	25
Stock 10 to 12 months old.									
July-August	...	35	* 6	17.1	29	82.9	...	...	† 3

* 3 have since died from stock dying back below the point of union.

† Average for three.

The distribution of budded plants given in the following table shows how with the budding of the Avocado, there has been a decrease in the sale of seedlings and an increase in that of budded plants.

NUMBER OF PLANTS DISTRIBUTED FROM ST. CLAIR.

				Budded	Seedling.
1911	...	...	...	—	363
1912	...	...	...	—	167
1913	...	...	...	—	49
1914	...	...	...	—	376
1915	...	...	...	4	85
1916	...	...	...	107	49
1917	...	...	...	143	20
1918	...	...	...	210	—
1919	...	...	...	379	—

ADVANTAGES OF BUDDING.

The advantages of budding plants over seedlings are:

(1.) *To ensure a select variety being kept true to type.* An increase was recently seen when a fruit from a seedling avocado tree weighed 2 lb. 2 oz., and the parent tree bore large fruits with seeds about the size of walnuts. On opening the fruit from the seedling tree it was not found to have the good characteristic of its parent, as of the 2 lb. 2 oz. of the fruit 10½ oz. was seed. See Fig. 1. (p. 116) of a fruit of the seedling.

On page 120 more has been said on this point and attention drawn to select varieties of which there are many in Trinidad for propagation.

(2.) *To ensure early fruiting.* Seedling and budded plants of the same kind growing side by side in the St. Clair Experiment Station have shown that whereas some of the budded plants commenced to fruit at three years of age, the seedlings although larger trees have not yet borne in their fifth year. Seedling trees can not be relied upon to fruit at as early an age as can budded plants.

(3.) *To prolong the fruiting season.* As is well known there are some varieties which fruit in Trinidad when the main crop is out of season. I was shown good fruits at Princes Town in January gathered from a single tree. A tree of this kind should be watched to see if it fruits each year out of season. If such is found to be the case it could be propagated by budding and this characteristic thus kept constant.

(4.) *To obtain a hardier root stock.* An advantage usually derived by budded plants viz: to bud on to a hardier root stock or one resistant to disease does not as yet appear to be important in the case of the Avocado as little difference is to be noticed in the constitution of different varieties. The only selection of stocks that can at present be advised is to choose seedlings for the purpose with strong vigorous shoots. Better primary successes are also obtained when budding on such stocks.

METHOD OF BUDDING.

The method used for budding is the same that generally adopted for roses and citrus, viz.: the T method. The patch method which is successful with Cacao is also sometimes used in the case of thick stocks.

SELECTION OF BUDS.—Branches from which buds should be taken must be chosen from mature wood about twelve months old; this is usually of a light brown colour. It is preferable to select buds from which the leaves have fallen, or to cut off the leaves leaving a few inches of the petiole attached, a few weeks before the buds are required. The buds should then be taken off with about ¼ to ½ of an inch of bark and inserted in the usual way.

SELECTION OF STOCKS.—In regard to the stocks on which the buds are to be inserted we have found it very important if success is to be assured that the stock be young. The proper age to bud and that at which to expect the best results is when the seedlings are from six weeks to five months old. In old stocks the chief reason of failure lies in the susceptibility of the bark to split when making the incision, resulting either in failure or a poor union. This does not happen in the case of young stocks.

The ideal stock for use is one with a strong thick shoot. Buds will unite much better and make stronger plants on sturdy stocks. The seed required for stock purposes are sown and grown in bamboo pots.

The method of top-working old trees by cutting them back and allowing shoots to grow which are then budded on, agrees with this in principle as it is the young shoots springing from the old pollarded branches upon which the buds are inserted.

SEASON FOR BUDDING.—Another very important factor and one which must not be overlooked is the season in which to bud. Unless a glass covered shelter is available in which to place the plants before a union has been made budding must be deferred till the early months of the dry season, selecting seeds from late fruits for use as stocks to allow of them being of the right age. Our experience at St. Clair has been that, even after budding under shelter, if the plants are exposed to heavy rains at too early an age many are lost.

GROWTH OF BUDS.—The most striking point about budding of the avocado is the marvellous rate of growth of the shoots once the buds have made a union with the stock. Occasionally we find buds make a good union but do not burst into growth, and on examination it is seen that the bud has dropped from the piece of bark inserted. The chief cause of this is through the bud being taken from shoots which are too young.

After the bud has made a union with the stock the latter should be trimmed off four or five inches above the point of union. It must not be trimmed back completely till the bud has made several inches of good strong growth and made a complete union with the stock. If the stocks are cut back closely before the buds have properly united the stock often dies back below the incision of the bud. This is one of the most important points in connection with the budding of the avocado.

As in the case of other budded and grafted plants a close watch must be kept for suckers which should be removed as soon as they appear.

INSECTS AFFECTING THE AVOCADO IN TRINIDAD AND TOBAGO.

By F. W. URICH,
Entomologist, Board of Agriculture.

THE full grown avocado tree is fairly free from insect pests and only occasionally suffers from scale insects with the resulting black blight and from the webbing caterpillars; in the early stages of its growth the avocado is more likely to suffer from insect pests and the seedling, the recently budded plant and the young tree cut back to form low branches should always be carefully examined for the first appearance of insect pests. During the dry season scale insects are under favourable conditions for increase and at the opening of the rainy season caterpillars may occur in numbers.

ANTS.

The stinging ant (*Solenopsis geminata*) is a serious pest to young plants not only does it encourage and protect all kinds of mealy bugs and scale insects but it will also bite off young bark from shoots and stems of the trees. In bad attacks fairly large branches can be entirely destroyed. Stinging ants can be controlled by destroying the nests with carbon bisulphide and cyanide of potassium or sodium.

The carbon bisulphide treatment is too well known to require description. Cyanide of potassium is also effective. For use take one ounce of the salt and dissolve it in one gallon of water: pour the solution into the nest until the ground is saturated. When using cyanide bear in mind that it is a deadly poison. Carbon bisulphide and cyanide will kill plants when the roots are touched. Other treatments are boiling water and puddling when nests are not situated in masonry. If a little resin wash is added to the boiling water it will make the treatment far more effective. When on the roots and stems of plants they can be sprayed with resin wash and nicotine, but frequent applications may be required as they return very soon from neighbouring nests. Trees can be protected by banding the stems and trunks with tree tanglefoot *see* formulæ 1, 2 and 3. Naphthalene flakes dusted around a plant will keep away ants for a few days.

Another species of ant found on the avocado tree is the acrobat ant, (*Cremastogaster brevispinosa*) which is not as bad as the stinging ant as it confines itself to the care of scale insects and mealy bugs and does not gnaw the bark of the tree. It makes its nest under loose dried bark and in rotten wood resulting from badly dressed pruning wounds or from dead branches left on the trees. Nests should be cut out as much as possible and the place painted over with crude oil or strong resin wash.

SCALE INSECTS AND MEALY BUGS.

The following scale insects and mealy bugs are found on avocado:—

- | | |
|------------------------------------|-------------------------------|
| 1. <i>Pulvinaria pyriiformis</i> . | 3. <i>Saissetia nigra</i> . |
| 2. <i>Aspidiotus destructor</i> . | 4. <i>Pseudococcus nipa</i> . |
| 5. <i>Pseudococcus citri</i> . | |

Pulvinaria pyriiformis is the most common of above and there is hardly an avocado tree that is entirely free from it. In severe infestations it causes black blight.

Most of the scale insects and mealy bugs can be controlled by natural enemies by keeping away ants from the trees. When numerous they can be sprayed with nicotine sulphate in combination with resin wash or soap, *see* formulæ Nos. 4 and 5.

WEBBING CATERPILLARS.

(*Stericta albifasciata*).

Sporadic attacks by these caterpillars take place, and young leaves and flowers of tall trees are destroyed. The caterpillars are gregarious and live in nests made by webbing leaves and branches with a tough silk, *see* fig. 2 which represents a single net while fig. 1 shows how a tree can be affected. The caterpillars, *see* fig. 3, are about one inch long when full grown, the general colour is dark brown with longitudinal yellow lines, the head is black and yellow. As a rule the caterpillars are controlled by natural enemies of which a *Tachina* fly *see* fig. 5 is the most important.

The moth expands about an inch. Its fore wings are light brown with dark brown mottlings, the hind wings are white with a slight purplish fringe. The male *see* fig. 4 has two conspicuous white spots on the fore wings which are absent on those of the female.

The caterpillars can be destroyed by cutting off and burning the nests, but this has to be done with care and despatch as the caterpillars when alarmed let themselves down to the ground by silken threads and disappear in the grass.

MINOR PESTS.

Selenothrips rubrocinctus, (the cacao thrips).

Heliothrips hæmorrhoidalis.

Aleurodicus neglectus (White flies).

White flies are only serious when attended by ants, they generally cause black blight under these conditions. For control use formulæ 4 or 5.

Formulæ.

No. 1.—ROSIN CASTOR OIL MIXTURE.*

This may be made according to the following formula:—

Rosin	...	...	...	pounds	5
Castor oil	...	...	...	fluid ounces	4½
					(or any fraction thereof).

Place the rosin and castor oil in a pot and heat slowly until the rosin is melted. Add more oil if too thick.

These sticky bands are sometimes injurious to the tree but injury may be avoided by spreading the adhesive on a strip of heavy paper encircling the tree trunk. A form of band that has given satisfactory results is made from cheap cotton batting and single-ply tarred building paper. The cotton should be cut into strips about 2 inches (3 inches would be better for Trinidad) wide and wrapped around the tree trunk so as to fill all crevices of the bark. Over the cotton is placed a strip of tarred paper about 5 inches wide, drawn tightly and securely tacked where it overlaps. The sticky material is then spread on top of the paper.

The sticky substance must be renewed from time to time, since when it dries out or becomes covered with dust or insects it fails as a barrier to crawling insects. If a combing instrument is occasionally

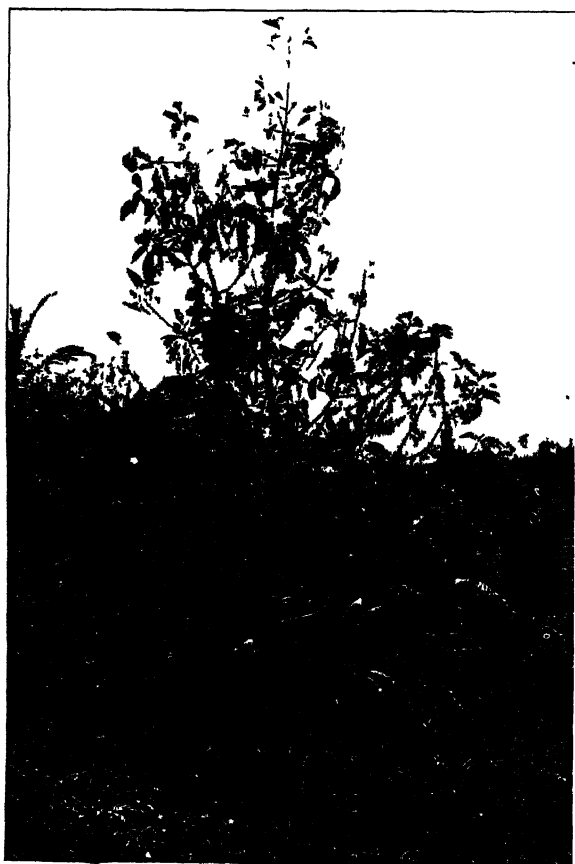


Fig 1. Avocado caterpillar, snowing webs and damage.



Fig. 2. Avocado caterpillar, single web.

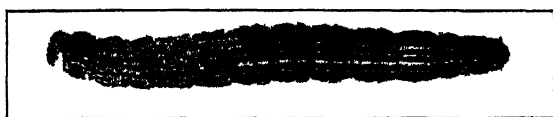


Fig. 3. Avocado caterpillar

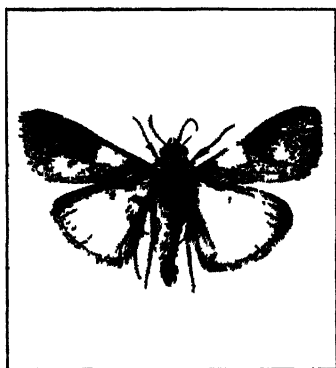


Fig 4. Avocado moth.

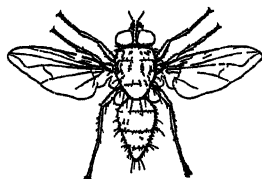


Fig. 5. Parasitic fly.

drawn over the band it will serve to lengthen the usefulness of the band by bringing some of the sticky portion to the surface.

Sticky fly paper is used sometimes in place of the sticky bands. This may be attached to the trunk by means of heavy twine tied tightly around the upper and lower edges, and properly should be put over a strip of cotton as described above.

No. 2.—AXLE-GREASE, FISH OIL AND ROSIN BANDING MATERIAL

A tree banding material used in Europe; reported as effective is made as follows:—

Axle-grease	...	...	...	pound	1
Fish oil	...	...	...	fluid ounce	1
Powdered rosin	...	...	...	pounds	2
(or any fraction thereof).					

Heat the axle grease, to remove all of the water contained therein. in a cooking vessel having a capacity of at least 1 gallon. Then stir in the fish oil and finally the powdered rosin a little at a time. When the latter is dissolved, remove from the fire and the mixture is ready for use the next day. Apply to tarred paper bands as already described.

No. 3.—TREE TANGLE FOOT.

A ready made mixture under above name is made by the O. & W. Thum Company of Grand Rapids, Mich., U.S.A.; the makers claim that it can be applied direct to the bark of trees and will not injure them. I have tried it without bad effects on lime trees. It remains sticky for several months.

No. 4.—RESIN WASH. (U.S. Dept. of Agr. Formula.) Stock Solution.

Powdered Resin	...	...	...	...	10 lb.
Caustic soda	...	...	...	...	2½ "
Whale oil	...	...	...	...	20 ounces.
Water	...	...	...	...	5 gallons.

The first two ingredients are placed in a kerosene oil tin with a gallon of water. Boil until the resin is melted then add Whale oil. Boil until liquid has a dark brown colour. From one to two hours will be necessary. Care should be taken that the liquid does not boil over and when water is added it should be poured in slowly and thoroughly mixed. Before taking off from fire add water and fill tin.

For use take one bottle (quart) of this stock and add to a kerosene tin full of water. This forms a strong solution that will kill most insects and not injure plants. Add nicotine sulphate at the rate of 1 oz. to every 5 gallons for mealy bugs.

No. 5.—NICOTINE SULPHATE OF BLACK LEAF 40.

Nicotine sulphate is a ready made insecticide of an excellent quality. It has good killing qualities and does not burn foliage easily. The labels of the makers give full directions for mixing. The following mixture will be useful.

Black Leaf 40	...	...	...	1½	teaspoonfuls.
Water	...	...	...	1	gallon.
Soap	...	...	...	1	ounce.

Black leaf 40 can be added to Bordeaux mixture and Resin wash.

* (United States Department of Agriculture Farmers' Bull. 908).

THE FUNGOUS DISEASES OF THE AVOCADO.

By JAMES BIRCH ROBER, M.A.,
Mycologist, Board of Agriculture.

With Two Plates.

As there are no regularly planted avocado groves in Trinidad up to the present time, but the trees are scattered through cacao and other cultivation, this fruit has remained fairly free from destructive attacks of fungous diseases.

On account of the recent interest which has been taken in this fruit, and the possibility of there being large plantings in the future, leading to an export trade, it is advisable at this time to call attention to the diseases which do occur, and which may at any time become epidemic, as one, at least, has already become in other countries.

The only serious disease, which has been observed up to the present time, attacking the fruit, is the so-called Anthracnose. This is caused by a fungus, identical, or at least, very closely related to that which causes Anthracnose of the mango, which has already been described in this *Bulletin*.*

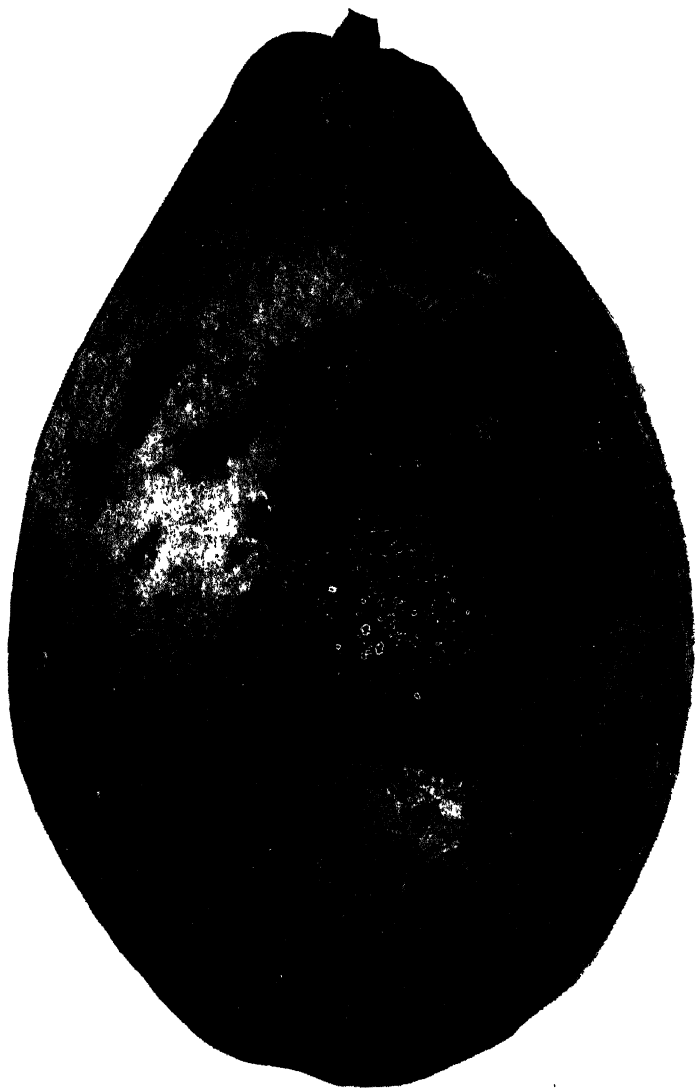
It is almost impossible to buy in the market an avocado fruit which is not attacked by this disease to a certain extent. As the fruit are consumed almost at once, no great amount of damage results from the infections, but if such fruits were packed for export, within a few days they would all become rotten, and the receiver would only get a crate or a box of avocado seeds in a mass of rotting pulp. All the Anthracnoses do an enormous amount of damage to fruit of various kinds during shipments.

SYMPTOMS OF ANTHRACNOSE.

The disease, as it attacks the avocado, appears first as a very small brown spot. If the attack takes place when the fruit is green, the diseased spot ceases to grow and becomes somewhat sunken and the fruit cracks around the margin; small black pimples may be noticed in the centre of the brown tissue. If the attack is bad, the young fruits fall to the ground prematurely, otherwise, the fruit may reach maturity, but the skin is cracked at the various places adjacent to the brown spots. When soft-skinned fruits are attacked, the fungus penetrates into the flesh and forms a cone-shaped mass of diseased tissue, which may extend all the way into the seed, and gradually rots the whole fruit. When attack takes place on ripe fruit, they rot very quickly, as shown in the figure.

As in the case of the mango, the fungus also attacks leaves, and causes a certain amount of defoliation.

* *Bull., Dept. Agr., Trinidad and Tobago, XIV, 1915. 164.*



Anthracnose of alligator pear.



DIB-BACK OF AVOCADO

TREATMENT.

The treatment for this disease follows closely that given for the Anthracnose of the mango. Sprayings with Bordeaux mixture must be made continually from the time of flowering until the fruits are mature. The frequency of the application must be determined by weather conditions. The more humid the weather, the greater the number of sprayings necessary.

If avocados are to be shipped for any distance, it is quite important to send fruits which have been sprayed. Though the skin may seem perfectly sound, the fruit is practically always infected by this fungus, for which the best conditions of growth are given when packed in crates or boxes.

THE DIE-BACK OF AVOCADOS.

Avocado shoots dying back are of frequent occurrence throughout the colony, and a microscopic examination has shown that these twigs are infected by the fungus *Diplodia cacaoicola*, which causes the "die-back" of cacao and rubber. Whether this fungus is able to get into uninjured shoots, has not yet been proved, but it is very probable that it gains entrance into the very young tissues through wounds made by the Anthracnose fungus, and when once in the shoots, grows rapidly down toward the trunk of the tree, killing the shoots for a distance of two or three feet from the tip.

The same fungus has been known to attack budded avocados, gaining entrance probably through the cuts made in the operation of budding. The same treatment recommended for the Anthracnose will serve to combat this disease.

COMPOSITION OF TRINIDAD AVOCADOS.

By H. S. SHREWSBURY, F.I.C., F.C.S.,
Acting Government Analyst.

The following is a report on Avocados grown in Trinidad, received from the Acting Director of Agriculture:

The fruits were gathered somewhat green and allowed to ripen until fit for the table. At this stage they were analysed.

The table below shows the number of fruits in each sample, with individual weights of whole fruit, skin, seed and pulp and percentage proportions of the bulked parts of the fruits.

For comparison with table showing analysis of pulp, the samples are arranged in the same order, viz., in descending magnitude of fat percentage.

COMPOSITION OF FRUIT.

Laboratory No.	Variety.	Weight in Grammes of				Bulked percentage composition.		
		Whole Fruit.	Skin.	Seed.	Pulp.	Skin.	Seed.	Pulp.
1058	River Estate							
	1	690	64	60	506			
	2	718	68	115	535	9.1	15.7	75.2
	3	736	62	129	565			
1031	No. 19							
	1	603	34	95	474			
	2	616	33	89	495	5.6	15.7	78.7
	3	627	36	105	486			
1049	Pollock							
	1	698	67	88	543	7.8	9.9	82.3
	2	786	30	59	677			
1030	St. Ann's							
	1	521	45	81	395			
	2	623	36	75	491	9.0	15.2	75.8
	3	697	65	122	510			
1048	Trapp							
	1	233	27	62	144	11.2	28.5	60.3
	2	235	25	72	138			
1077	Trapp							
	1	169	21	48	100			
	2	222	26	73	123	11.2	29.2	59.6
	3	317	32	87	199			

ANALYSIS OF PULP.

The pulps from all the fruits in each sample were bulked and analysed, when the following data were obtained:—

COMPOSITION OF PULP.

Variety.	PERCENTAGE OF									Food units.
	Water.	Oil.	Soluble Carbohydrates.			Resins.	Woody Fibre.	Proteins.	Ash.	
			Reducing Sugar.	Non-reduc- ing Sugar.	Non-Sugar.					
River Estate ...	84.7	7.6	2.9	0.6	0.9	0.7	1.0	1.3	0.3	27
No. 19 ...	82.4	6.5	3.5	1.3	1.6	2.0	1.2	1.2	0.3	28
Pollock ...	86.1	6.1	2.9	1.1	1.1	0.2	1.0	1.0	0.5	23
St. Ann's ...	86.4	5.2	2.7	0.8	1.3	1.7	0.7	0.9	0.3	22
Trapp ...	89.5	2.5	2.3	1.6	0.4	0.9	0.9	0.8	0.1	16
Trapp ...	89.4	2.5	3.5	0.6	1.1	0.5	0.8	1.3	0.3	15

FOOD UNITS.

For comparison with the food units, the figure for pickled ripe olives may be taken as 81, indicating that olives have three times the food value of the best variety of avocado analysed, viz., River Estate.

The comparison is not strictly fair, since olive oil is essentially different from avocado oil, which resembles coconut oil in type. The comparison is probably unfavourable to the olives.

DATA COMPARED WITH AMERICAN DATA.

Twenty-eight varieties of avocado, analysed at Berkeley, California (University of California Publications, Bulletin 254) ranged from 61 to 79 per cent. of water, and 10 to 29 per cent. of fat.

As one of these varieties was the Trapp, a direct comparison may be made between data for Trapp grown in California and in Trinidad, as exhibited in the following table:—

COMPARISON OF TRAPP, CALIFORNIA WITH TRAPP, TRINIDAD.

Variety.	Weight of Fruit in grammes.	Percentage of			Percentage Composi- tion of Pulp.					Percentage Composition of Dry Pulp.			
		Skin.	Seed.	Pulp.	Water.	Oil.	Carbo- hydrates.	Proteins.	Ash.	Oil.	Carbo- hydrates.	Proteins.	Ash.
California.	638	8.2	20.3	71.5	78.7	9.8	9.1	1.6	0.8	46.0	42.7	7.1	4.2
	109												
	222	11.2	28.5	60.3	80.5	2.5	6.1	1.8	0.1	23.8	58.0	17.1	1.1
Trinidad ..	233												
	235	11.2	29.2	59.6	80.4	2.5	6.5	1.3	0.3	23.6	61.3	12.3	2.8
	317												

The California fruit is much heavier, with lighter skin and seed and heavier pulp. Not only is there a considerably larger percentage of pulp, but the pulp itself is not so watery as that of the Trinidad samples, and contains much more oil.

Comparing the dry pulps, the Californian sample contains twice as much oil and a much heavier ash, with smaller percentages carbohydrates and proteins.

Comparing the five varieties grown in Trinidad with the twenty-eight grown in California, the lowest percentage of water in the Trinidad samples (82.4) is higher than the highest figure for the Californian samples (79): similarly the highest oil figure (Trinidad)—(7.6) is lower than the lowest Californian figure (10).

SUGAR.

SUGAR CANE EXPERIMENTS 1917-19.

Trinidad Seedlings & Tests of Varieties.

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THE report on sugar-cane experiments may be divided into two parts:—

- (1.) Raising and testing of new seedlings.
- (2.) Results of tests of varieties grown in plots.

RAISING AND TESTING OF NEW SEEDLINGS.

Seedling canes were raised in Trinidad, on a large scale for the first time in 1895 by the late J. H. Hart, F.L.S., Superintendent of the Royal Botanic Gardens and continued until 1904. From then no seedlings were raised by Government Officers until 1917 when, on the initiative of His Excellency the Governor, the work was resumed by the Department of Agriculture.

In September, 1918, the question of raising the seedlings was reconsidered by the Sugar Committee of the Board of Agriculture and it was decided that centralization of the work at St. Augustine Experiment Station was preferable so that all the work in connection with the raising, growing and testing of seedling canes has now been entrusted to the Superintendent of Field Experiments.

In addition to raising ordinary seedlings by collecting and sowing arrows from good varieties when the seed is ripe attempts will be made to obtain:—

(a.) *Natural hybrids* i.e. seedling canes obtained by planting some of the best varieties chess-board fashion, and before the flowers open, bagging the inflorescences of two different varieties together so as to ensure that the seedlings obtained are either crosses of the two varieties bagged or self-fertilized. In this case as far as possible, varieties producing a high percentage of sucrose are crossed with varieties giving a high tonnage of canes per acre.

(b.) *Self-fertilized seedlings* obtained by bagging some of the best varieties before the anthers open so as to ensure that they are not cross-fertilized.

SEEDLINGS RAISED IN 1917.

Out of the seedlings raised and potted in 1917, 1,287 were planted out in the field in June, 1918, representing 256 natural hybrids and 981 ordinary seedlings. Of these 205 or 16.5 per cent. were selected from their field characters for analytical test and 49 or 3.9 per cent. have been selected for a second trial.

It would appear from the first year's results that certain varieties are useless for raising new seedlings and the detection of good parents seems to be of great importance as will be seen below :

TABLE I.—SUGAR-CANE SEEDLINGS RAISED IN 1917.

PARENT CANE.	Number of Seedlings planted out in field.	Selected for testing from field characters.	Selected for further trial from field characters and analytical results.
B. 6388	3	0	0
B. 156	16	0	0
H. 27	112	2 = 1·8 per cent.	0
T. 75	408	24 = 5·9 „	0
D. 116	61	9 = 15·0 „	0
D. 625 x B. 6385	60	8 = 13·3 „	1 = 1·6 per cent.
D. 625 x B. 6388	28	5 = 17·8 „	1 = 3·6 „
D. 625 x Badilla	88	20 = 22·7 „	5 = 5·7 „
D. 625 x B. 208	80	12 = 15·0 „	5 = 6·2 „
Bourbon	286	90 = 31·5 „	22 = 7·7 „
B. 6308	20	4 = 20·0 „	2 = 10·0 „
H. ? (1)	76	31 = 40·8 „	18 = 17·1 „

None of the seedlings raised from B. 6388 and B. 156 were sufficiently good to warrant the juice being tested. Out of 112 H. 27 and 408 T. 75 seedlings only 2 and 24 respectively exhibited sufficiently good field characters and when these were tested none came up to the mark. Similarly none of the D. 116 seedling past the analytical test out of the 9 selected for their field characters. Only one each of the crosses between D. 625 and B. 6385 and B. 6388 has been kept for a second trial; this represents 1·6 and 3·6 per cent. respectively of the number grown. Five each of the crosses between the Badilla and B. 208 with D. 625 have been kept for further trial. Out of the 286 Bourbon seedlings raised, 90 or 31·5 per cent. were selected for their field characters and 22 or 7·7 per cent. are being kept for a second trial. Two seedlings raised from B. 6308 out of twenty are also being kept and out of 76 H. ? seedlings 31 or 40·8 per cent. were selected for analysis and of these 18 or 17·1 per cent. of the number grown have given juice of good quality.

The following are the results of the seedlings raised in 1917, which have been selected for their combined field characters and analytical results and are being kept for a further trial. They were planted out in the field from bamboo pots in June 1918 and were consequently only eleven months old when tested between May 16 and 29, 1919. The rainfall from June 1918 to May 15, 1919 was 51·72 inches but from January to March, 1919 only 1·68 inches of rain fell and during this period the seedlings made very little growth.

(1.) A Hawaiian cane received without a number owing to the label having become illegible on the journey.—(ED.)

TABLE II.—SEEDLINGS RAISED IN 1917.—FIRST YEAR'S SELECTION.

CANE.	Parent.	Weight of Stool.	Average weight of Canes.	JUICE.								Quotient of purity.	Sucrose per gallon.
				Per cent. extracted.	Specific gravity.	Brix.	Percentage of						
							Sucrose.	Glucose.	Non-Sugar.				
		Lb.	Lb.									Lb.	
T. 702 Bourbon	..	167.0	5.4	64.1	1.0682	16.6	12.73	2.13	1.74	76.7	1.360		
T. 320 Bourbon	..	64.5	5.4	68.4	1.0682	16.6	13.41	2.45	0.74	80.8	1.432		
T. 570 Bourbon	..	78.5	4.5	68.3	1.0669	16.3	13.72	1.48	1.10	84.2	1.404		
T. 301 Bourbon	..	81.5	5.1	67.6	1.0682	16.6	13.80	1.48	1.32	83.1	1.474		
T. 500 Bourbon	..	113.5	4.7	64.2	1.0687	16.7	14.09	1.40	1.21	84.4	1.506		
T. 334 Bourbon	..	47.0	3.9	67.3	1.0674	16.4	14.54	1.26	0.60	88.6	1.552		
T. 499 Bourbon	..	168.0	5.4	65.4	1.0722	17.5	14.72	1.03	1.15	84.1	1.578		
T. 329 Bourbon	..	46.3	3.9	70.7	1.0704	17.1	14.79	1.53	0.78	86.5	1.583		
T. 302 Bourbon	..	42.5	5.3	66.2	1.0691	16.8	14.81	1.26	0.73	88.1	1.583		
T. 372 Bourbon	..	58.8	4.5	66.1	1.0730	17.7	15.10	1.81	0.79	85.3	1.620		
T. 305 Bourbon	..	49.0	3.1	68.6	1.0735	17.8	15.24	1.88	0.68	86.6	1.636		
T. 360 Bourbon	..	76.0	3.8	68.6	1.0744	18.0	15.37	1.81	0.82	85.4	1.651		
T. 356 Bourbon	..	35.7	5.1	68.0	1.0700	18.6	15.48	2.13	0.99	83.2	1.667		
T. 373 Bourbon	..	86.5	3.9	70.1	1.0739	17.9	15.72	1.48	0.70	87.8	1.688		
T. 364 Bourbon	..	75.5	3.4	68.4	1.0766	18.5	15.73	1.63	1.14	85.0	1.693		
T. 381 Bourbon	..	41.7	5.2	63.6	1.0744	18.0	15.90	1.32	0.78	88.3	1.708		
T. 348 Bourbon	..	64.0	5.3	65.0	1.0761	18.4	16.31	1.36	0.73	88.6	1.775		
T. 378 Bourbon	..	55.0	5.5	70.9	1.0757	18.3	16.51	1.09	0.70	90.2	1.776		
T. 497 Bourbon	..	101.5	2.7	61.9	1.0806	19.4	16.63	1.09	1.68	85.7	1.797		
T. 343 Bourbon	..	38.0	5.4	64.8	1.0766	18.5	17.03	0.98	0.49	92.0	1.833		
T. 362 Bourbon	..	26.5	3.3	60.6	1.0810	19.5	17.15	1.53	0.82	87.9	1.854		
T. 400 Bourbon	..	147.0	2.6	61.1	1.0797	19.2	17.27	1.04	0.89	89.9	1.865		
T. 413 H. ?	..	48.0	4.8	64.8	1.0704	17.1	14.89	1.44	0.77	87.1	1.894		
T. 399 H. ?	..	45.0	3.2	64.7	1.0761	18.4	16.65	1.04	0.71	90.5	1.792		
T. 408 H. ?	..	64.0	4.0	59.6	1.0788	19.0	16.71	0.73	1.56	88.0	1.803		
T. 345 H. ?	..	24.5	4.1	58.4	1.0775	18.7	16.87	0.94	0.89	90.2	1.818		
T. 410 H. ?	..	28.3	3.1	62.3	1.0770	18.6	17.07	0.78	0.75	91.8	1.838		
T. 415 H. ?	..	37.1	3.4	64.5	1.0761	18.4	17.38	0.47	0.55	94.4	1.870		
T. 406 H. ?	..	34.5	5.8	56.7	1.0801	19.3	17.41	0.82	1.07	90.2	1.880		
T. 420 H. ?	..	43.7	3.6	60.0	1.0810	19.5	17.69	0.98	0.93	90.2	1.901		
T. 411 H. ?	..	45.5	3.5	63.5	1.0801	19.3	17.65	1.02	0.63	91.4	1.906		
T. 409 H. ?	..	52.9	4.1	63.5	1.0832	20.0	17.70	0.91	1.30	88.5	1.917		
T. 412 H. ?	..	40.5	4.4	64.3	1.0824	19.8	18.20	0.91	0.60	92.4	1.980		
T. 402 H. ?	..	52.5	2.2	64.0	1.0824	19.8	18.91	0.63	0.26	95.5	2.047		
T. 407 H. ?	..	55.5	3.5	59.7	1.0932	22.2	20.20	0.39	1.61	91.0	2.208		
T. 424 B. 6308	..	61.9	2.9	67.2	1.0717	17.4	14.78	1.53	1.09	84.9	1.584		
T. 422 B. 6308	..	70.0	4.4	68.0	1.0766	18.5	16.45	1.26	0.79	88.9	1.771		
T. 462 D. 625 x Badilla.	..	45.0	2.5	62.5	1.0753	18.2	15.50	1.75	0.95	85.2	1.667		
T. 452 D. 625 x Badilla.	..	52.5	2.4	63.1	1.0792	19.1	17.29	1.26	0.56	90.5	1.885		
T. 459 D. 625 x Badilla.	..	32.0	2.7	61.3	1.0828	19.9	18.14	1.14	0.72	90.6	1.953		
T. 455 D. 625 x Badilla.	..	45.5	2.8	62.9	1.0832	20.0	18.47	0.71	0.82	92.3	2.001		
T. 457 D. 625 x Badilla.	..	25.0	2.8	62.2	1.0900	21.5	20.07	0.70	0.73	93.3	2.188		
T. 475 D. 625 x B. 6835	..	61.4	4.1	65.1	1.0704	17.1	14.31	1.81	0.98	83.7	1.532		
T. 481 D. 625 x B. 6338	..	53.0	2.0	64.4	1.0761	18.4	16.70	0.87	0.83	90.8	1.797		
T. 503 D. 625 x B. 208	..	53.0	2.4	67.2	1.0704	17.1	14.63	1.75	0.80	85.1	1.557		
T. 491 D. 625 x B. 208	..	55.0	4.6	62.5	1.0775	18.7	15.61	1.00	1.89	84.5	1.708		
T. 488 D. 625 x B. 208	..	33.5	2.1	66.0	1.0824	19.8	17.81	0.70	1.29	89.9	1.928		
T. 489 D. 625 x B. 208	..	23.0	2.1	60.5	1.0824	19.8	18.29	0.72	0.79	92.4	1.980		
T. 487 D. 625 x B. 208	..	32.0	4.6	61.9	1.0828	19.9	18.43	0.66	0.81	92.6	1.996		

Although a few of these seedlings might appear hardly worthy of retention it is considered preferable, especially at the start to err on the side of leniency. Generally it will be seen from the above that the seedlings raised from the Bourbon gave the largest weight of canes and those from H. ? the best juice.

The stools of these selected canes have been dug up, divided into two or three according to their size, replanted and carefully labelled on a plan showing the position of each stool. When these canes grow up, cuttings will be planted out in plots about October–November and grown in competition with standard varieties such as Bourbon, B. 156, Badilla, B. 6450 or B. 6032. From the results obtained a further selection will be made, only those varieties which give very good results will be kept and planted in larger plots.

SEEDLINGS RAISED IN 1918.

About 8,000 seedlings were raised in 1918; of these over 3,000 were potted and 2,000 of the most vigorous planted out in the field at the beginning of May, so that when tested next year they will be fully 12 months old.

This year about 50 seedlings were planted out weekly from the beginning of April as an experiment and the results have been so satisfactory that it is proposed in future to plant out the bulk of the seedlings in April instead of waiting for the first rains in May. The greatest danger is that the young plantlets are liable to be cut by mole crickets but these have been successfully kept under control by the use of a protective bamboo collar. The extra growth obtained from early planting out more than compensates for the few plants destroyed, moreover there is a better chance of the canes coming to maturity, as they will have been thirteen months in the ground when cut for testing.

RESULTS OF TESTS OF VARIETIES.

With the exception of Field 7, which was under the control of the St. Augustine Estate authorities, the canes under report were grown at the Experiment Station, St. Augustine, and consist of plant canes, first and second ratoons. Plant canes received an application of pen manure at the rate of about 15 tons per acre. No manures were applied to ratoons and all the canes received ordinary estate cultivation.

During the period under review the cultivation suffered very little from froghoppers, but the Bourbon in Field 10 Valsayn (first ratoons) was severely hit by root disease.

The results obtained from the plant canes are recorded in Tables III to V, those from the first ratoons in Tables VI and VII; Table VIII gives the results for the second ratoons and Tables IX and X the average results for plants and ratoons.

Information with regard to the date of planting, and testing of the juice is given at the head of the Tables.

The plant canes in Field 9, Valsayn, Table III, were 22 months old when reaped. They were planted on June 5, 1917 with the intention of reaping them twelve months later but as the Factory finished grinding during the first week of May and the canes were still short it was considered preferable to allow them to stand over. The average yield for the whole field was 82.42 tons of canes per acre.

TABLE III.—PLANT CANES.

CANE.	Area under culti- vation.	JUICE.								PER ACRE.			
		Per cent. extracted.	Specific Gravity.	Brix.	Percentage of			Quotient of purity.	Sucrose per gallon.	Canes.	Juice.	Sucrose in Juice.	
					Sucrose.	Glucose.	Non- Sugar.						
I.P. 55	...	12,801	66.1	1.0695	16.9	13.98	2.04	0.88	82.7	1.495	43.09	5,965	3.98
. 511	...	6,754	65.3	1.0864	20.7	18.99	0.70	1.01	91.7	2.063	29.42	3,961	3.65
White Tanna	...	11,523	59.9	1.0797	19.2	16.79	1.22	1.19	87.4	1.813	35.30	4,387	3.55
L. 90 th	...	8,225	63.3	1.0591	14.5	11.85	1.81	0.84	81.7	1.255	28.40	3,802	2.13
B. 7482	...	3,840	65.1	1.0730	17.7	13.88	1.75	2.07	78.4	1.489	23.40	3,180	2.11
L. 218	...	1,742	62.5	1.0788	19.0	16.76	1.14	1.10	88.2	1.808	19.38	2,515	2.03
L. 253	...	2,730	65.5	1.0669	16.3	13.43	1.75	1.12	82.4	1.433	18.94	2,605	1.67

The results from the plant canes in Field 1, St. Augustine, are given in Table IV. These canes were tested at the end of March and April when they were 16½ and 17½ months old respectively. Generally the results show a substantial improvement in the quality of the juice when tested in April compared with the results obtained in March. The lower results obtained in April from Badilla and B. 14761 as also the very small improvement shown for B. 10650 is due to the fact that the stools selected for analysis remained in the field for seven days after they had been topped owing to an accident to the cane-mill. The juice had a decided acid reaction and the deterioration of the juice is further shown by the increase in the percentage of glucose and the decrease in the quotient of purity. It is probable that the same marked improvement would have been obtained for B. 10650 and B. 14761, under normal conditions, as shown for the other varieties. The Badilla and H? appear to have come to maturity by the end of March. These results confirm those obtained during the past two years viz.: that with few exceptions, plant canes do not come to maturity at St. Augustine before the month of April.

The highest results were obtained from M. P. 55 a seedling from Mauritius, but this variety owes its position solely to the high tonnage of canes reaped per acre, for as will be seen in the table below, the quality of the juice is much inferior to that of any of the other varieties. The next best results were obtained from B. 14761, Ba. 6082, B. 8922, B. 6808, B. 156, B. 6888 and H.? Eighteen varieties have given better results than the Bourbon and the average for the whole field was 33.58 tons of cane per acre.

TABLE IV*.—PLANT CANES.—Continued.

CANE.	Area under culti- vation.	JUCOR.					PER ACRE.								
		Per cent. extracted.	Specific gravity.	Dry.	Percentage of		Sucrose per gallon.	Caney.	Juice.	Tons.					
					Sucrose.	Glucose.					Non- sugar.	(Quotient of purity.			
H. ?	...	{ ... }	{ (a) } { (b) }	Sq. ft. 10,736 {	61.3 65.2	1.0819 1.0850	19.7 20.4	17.35 17.88	1.36 1.75	1.01 1.27	88.0 85.2	Lb. 1,875 1,886	Tons. 37.02	Juice. 4,983	Tons. 4.19
B. 4934	...	{ ... }	{ (a) } { (b) }	11,110 {	62.7 62.5	1.0753 1.0761	18.2 18.4	16.52 17.04	1.06 0.79	0.62 0.57	90.8 92.1	1,776 1,834	36.15	4,699	3.85
B. 7482	...	{ ... }	{ (a) } { (b) }	5,258 {	65.3 68.4	1.0757 1.0806	18.3 19.4	15.69 16.87	1.09 1.36	0.92 1.17	85.7 86.9	1,688 1,823	33.24	4,713	3.83
B. 16736	...	{ ... }	{ (a) } { (b) }	7,766 {	67.1 70.7	1.0713 1.0739	17.3 17.9	14.20 15.28	1.88 1.88	1.22 0.74	82.1 85.4	1,521 1,641	34.78	5,129	3.76
Badilla	...	{ ... }	{ (a) } { (b) }	11,220 {	60.5 61.9	1.0914 1.0859	21.8 20.6	20.09 18.71	1.00 1.11	0.71 0.78	92.1 90.8	2,193 2,032	30.67	3,808	3.73
L. £11	...	{ ... }	{ (a) } { (b) }	10,874 {	66.1 68.4	1.0841 1.0904	20.2 21.6	18.02 20.21	0.75 0.54	1.43 0.85	80.2 93.6	1,953 2,204	26.74	3,757	3.69
B. 10650	...	{ ... }	{ (a) } { (b) }	9,152 {	69.2 71.0	1.0700 1.0717	17.0 17.4	11.31 16.63	1.48 1.48	1.21 1.29	81.2 84.1	1,531 1,568	33.32	4,945	3.46
D. 504	...	{ ... }	{ (a) } { (b) }	11,044 {	62.4 65.0	1.0779 1.0801	18.8 19.3	15.56 16.59	1.06 1.88	1.28 0.83	82.8 86.9	1,677 1,791	30.96	4,173	3.34
M. 146	...	{ ... }	{ (a) } { (b) }	10,384 {	63.6 65.9	1.0744 1.0819	18.0 19.7	15.27 17.62	1.06 1.36	0.77 0.72	84.8 89.4	1,641 1,906	28.16	3,812	3.27

Small plots of the two latest introductions from Barbados were planted in Field 8, Valsayn, on November 11, 1917, and reaped on April 15, 1919 at 17 months of age. They gave the following results:—

Ba. 7924 on a plot of 625 sq. ft. gave a return at the rate of 28·75 tons of cane containing 3·81 tons of sucrose in the juice per acre. On analysis the canes gave 66·9 per cent. of juice containing 17·23 per cent. Sucrose, 0·89 per cent. Glucose, 93·6 per cent. Quotient of purity, and 1·854 lb. of sucrose per gallon of juice.

B.H. 10 (12) on a plot of 2,125 sq. ft. gave a return at the rate of 27·93 tons of cane containing 3·28 tons of sucrose in the juice per acre. On analysis the canes gave 64·2 per cent. of juice containing 18·29 per cent. Sucrose, 1·29 per cent. Glucose, 92·4 Quotient of purity, and 1·980 lb. of sucrose per gallon of juice.

The plant canes in Field 7, St. Augustine, Table V, were 17½ months old when reaped. The best results were obtained from E. 6808, Badilla, B. 156, B. 6450, D. 504 and B. 1753; all the other varieties gave rather poor results, which in a great measure may be accounted for by the fact that that portion of the field adjoins a cacao field and is overshadowed by immortal trees. This field gave an average of 24·44 tons of canes per acre.

RATOON CANES.

The first ratoons in Field 1, Valsayn, were reaped on April 10, 1919 at eleven months of age. An average yield of 25.01 tons of cane was obtained per acre and the results are given in Table VI.

The results from the first ratoons in Field 10, Valsayn, are recorded in Table VII. The canes from this plot were reaped as plant canes at the beginning of May 1918, being 19 months old; as first ratoons they were cut at twelve months of age. In this field there were twenty-three varieties under experiment, all of which have given better results than the Bourbon which were severely attacked with root disease. The whole field gave an average yield of 19.56 tons of canes per acre and the best results were obtained from B. 6309 followed by B. 4934, B.A. 6032, Ladilla, B. 347, B. 376, B. 166, &c.

TABLE VI.—FIRST RATOONS.

Date planted Plants reaped and tested	CANE.	Area under culti- vation.	Per cent. extracted.	Specific gravity.	Brix.	JUICE.				Quotient of purity.	Sugar per gallon.	PER ACRE.		
						Percentage of		Cane.	Juice.					
						Sucrose.	Glucose.							
		Sq. ft.									Lb.	Tons.	Gals.	Tons.
M. 1237	3,300	63.7	1.0717	17.4	11.58	1.96	0.86	83.8	1.562	31.51	4,195	2.92	
Striped	6,980	65.0	1.0753	18.2	10.28	1.40	0.52	89.4	1.750	26.95	3,049	2.85	
M.P. 55	3,680	68.3	1.0687	16.7	12.47	2.72	1.11	77.1	1.375	31.80	4,552	2.79	
White Tanna	3,680	63.8	1.0744	18.0	11.86	2.18	0.96	82.5	1.596	25.50	3,392	2.42	
B. 7482	3,680	64.0	1.0864	20.7	18.80	1.69	0.81	90.8	2.042	18.75	2,474	2.25	
M. 909	6,600	59.4	1.0660	16.3	13.62	1.81	0.87	83.5	1.433	18.73	2,336	1.51	

Nov. 23, 1916 Field No. 1, Valsayn.
May 11, 1918-17¹/₂ month, old.

Ratoons reaped and tested
Rainfall

April 10, 1919-11 month, old.
May 1918 to March 1919-58.55 inches.

TABLE VII.—FIRST RATOONS.

CANE.	Date planted Plants reaped and tested	...	Oct. 10, 1916—Field 10, Valsayn. ... May 10, 1918—19 months old.	Ratoons reaped and tested Rainfall				...	May 14, 1919—12 months old. ... May 1918 to April 1919—54.37 inches.	PER ACRE.							
				Area under cultivation	Per cent. extracted.	Specific gravity.	Brix.			Percentage of			Quotient of purity.	Sugar per gallon.	Canes.	Juice.	Sucrose in juice.
										Sucrose.	Glucose.	Non- Sugar.					
Sq. Ft.	69.9	1.0806	19.4	17.74	0.98	0.68	1.917	32.29	4,679	4.00							
B. 6308	10,287	64.7	1.0824	19.8	18.53	0.57	2.006	30.31	4,058	3.63							
B. 4934	10,071	63.9	1.0788	18.9	17.05	0.69	1.888	27.45	3,644	2.99							
Ba. 6032	9,125	65.3	1.0837	20.1	17.98	0.68	1.943	25.87	3,435	2.98							
Badilla	7,800	67.3	1.0748	18.1	15.85	0.67	1.708	27.24	3,906	2.97							
B. 347	10,778	68.8	1.0709	18.8	17.25	0.61	1.859	23.67	3,809	2.75							
B. 376	13,187	67.4	1.0819	19.7	17.48	1.16	1.891	23.77	3,253	2.75							
B. 156	7,382	66.1	1.0810	19.6	17.35	0.69	1.875	23.88	3,236	2.71							
B. 6388	7,848	66.8	1.0850	20.4	18.96	1.48	2.057	22.17	2,952	2.71							
B. 208	10,166	64.5	1.0779	18.6	15.51	1.06	1.672	25.57	3,608	2.69							
B. 109	5,140	67.9	1.0824	19.8	17.42	1.06	1.885	20.84	2,789	2.44							
T. 75	5,670	64.9	1.0797	19.2	17.08	0.87 <th>1.937</th> <th>19.89</th> <th>2,696</th> <th>2.22</th>	1.937	19.89	2,696	2.22							
T. 116	5,772	65.6	1.0824	19.8	17.90	0.99	2.125	16.55	2,516	2.17							
H. ?	5,980	62.7	1.0877	21.0	19.54	0.82	2.042	15.43	2,086	1.98							
B. 6385	8,870	61.2	1.0885	20.5	18.76	0.88	2.115	14.85	1,998	1.75							
T. 39	5,859	66.6	1.0753	18.2	15.89	0.86	1.709	17.16	2,316	1.77							
B. 6450	8,944	64.8	1.0744	18.0	15.95	0.86	1.714 <th>17.91</th> <th>2,300</th> <th>1.76</th>	17.91	2,300	1.76							
B.N.H. 02 (1)	5,319	61.6	1.0744	18.0	15.95	0.86	1.714 <th>17.91</th> <th>2,300</th> <th>1.76</th>	17.91	2,300	1.76							
B. 3922	8,064	65.0	1.0819	19.7	18.10	0.73	1.968	14.85	1,998	1.75							
B.N.H. 02 (5)	5,805	60.6	1.0770	18.6	16.20	0.87	1.745	17.16	2,163	1.68							
T. 202	11,284	65.6	1.0837	20.1	18.51	0.73	2.006	11.48	1,597	1.39							
H. 227	5,902	62.5	1.0748	18.1	15.80	1.14	1.693	12.87	1,676	1.27							
H. 27	5,750	63.1	1.0864	20.7	18.27	1.63	1.985	10.53	1,370	1.21							
Bourbon	10,200	68.9	1.0730	17.7	14.81	1.26	1.589	10.67	1,535	1.09							

The canes in Field 1, St. Augustine, were reaped in 1917 as plant canes, in 1918 as first ratoons and in April 1919 as second ratoons at approximately 12 months of age. Thirty-five varieties were reaped as plants and first ratoons and twenty-four as second ratoons; the other eleven varieties being cut for plants in September 1918. Notwithstanding this heavy thinning out for plants the whole field gave an average of 21.28 tons of cane per acre. The results of the twenty-four varieties which were tested and reaped separately are given in Table VIII; the best results were obtained from T. 75, D. 145, B. 208, B. 156, B. 147, D. 109, and B. 876. With the exception of H. 27 and B. 4578 all the varieties gave higher results than the Bourbon.

TABLE VIII.—SECOND RATOONS.

Date planted September 1915—Field 1, St. Augustine. *1st Ratoons reaped and tested*... March-April 1918—12 1st months old.
Plants reaped and tested March 1917. *2nd Ratoons reaped and tested*... April 1919 12 months old.
Rainfall April 1918 to March 1919 31.27 inches.

CANE.	Area under culti- vaton. Sq. ft.	JUICE.						PER ACRE.		
		Per cent. extracted.	Specific gravity.	Brix.	Percentage of			Cane.	Juice.	Sucrose in juice.
					Sucrose.	Non- Sugar.	Quotient of purity.			
T. 75	3,927	66.0	1.0788	19.0	16.47	1.69	86.7	Tons.	Gals.	Tons.
D. 145	11,500	63.1	1.0730	17.7	15.10	2.13	85.3	28.42	3,895	3.09
B. 208	6,390	64.8	1.0846	20.3	19.11	0.73	91.1	31.72	4,178	3.02
B. 156	11,000	63.3	1.0819	19.7	17.37	1.44	89.2	23.51	3,150	2.91
B. 147	4,232	69.5	1.0723	17.5	13.21	1.69	86.9	25.98	3,405	2.89
D. 109	5,500	65.3	1.0792	19.1	16.60	2.04	86.4	1.631	3,830	2.79
B. 376	13,371	64.9	1.0757	18.3	16.76	1.36	91.6	25.24	3,421	2.75
B. 504	5,588	62.5	1.0819	19.7	16.95	1.75	86.0	24.79	3,350	2.70
D. 3956	5,166	64.9	1.0775	18.7	14.94	2.46	79.9	21.94	3,227	2.64
B. 1753	11,385	61.7	1.0748	18.1	15.85	1.44	87.6	27.00	3,055	2.63
								26.88	3,456	2.63

TABLE VIII.—SECOND RATOONS.—(Continued).

Date planted

September 1915—Field No. 1, St. Augustine.

1st Ratoon reaped and tested .. March–April 1918—12–12½ months old.

Plants reaped and tested

.. March 1917 .. 17–18 months old.

2nd Ratoon reaped and tested .. April 1919 .. 12 months old.

Rainfall, April, 1918, to March, 1919

51.27 inches.

CANE.	Area under culti- vation.	Per cent. extracted.	Specific gravity.	Brix.	Juice.				PER ACRE.		
					Sucrose.	Non- Sugari- ness.	Quantity of purity.	Shall one per gallon.	Cane.	Juice.	Sucrose in Juice.
	Sq. ft.							Lb.	Tons.	Cals.	Tons.
D. 116	10,500	65.6	1.0788	19.0	16.42	1.75	86.4	1.771	24.06	3,277	2.59
Ba. 6032	43,965	67.4	1.0704	17.1	14.75	1.58	86.2	1.579	25.90	3,606	2.58
D. 2468	12,000	66.4	1.0735	17.8	14.05	2.21	82.5	1.574	26.09	3,615	2.51
T. 39	1,048	68.2	1.0810	19.5	17.19	1.22	89.7	1.891	20.96	2,962	2.50
T. 202	3,927	64.3	1.0815	19.6	17.18	1.36	89.2	1.890	22.05	2,936	2.48
B. 8390	5,566	64.7	1.0744	18.0	15.13	2.33	91.0	1.425	21.55	3,311	2.40
B. 3412	5,544	65.7	1.0730	17.7	13.98	2.58	79.0	1.500	26.12	3,582	2.40
B. 7169	5,566	65.5	1.0739	17.9	14.30	1.46	81.6	1.568	24.94	3,407	2.38
D. 115	5,250	64.1	1.0770	18.6	16.15	1.81	86.8	1.739	22.61	3,014	2.34
Radilla ...	11,000	63.1	1.0850	20.4	18.43	1.29	90.3	2.000	23.21	3,023	2.25
D. 366	10,500	63.0	1.0770	18.6	16.40	1.18	88.6	1.776	19.79	2,716	2.15
B. 10832	5,584	68.5	1.0634	15.5	12.15	2.13	78.4	1.392	25.11	3,622	2.09
Bourbon	10,978	63.2	1.0770	18.6	16.44	1.44	83.9	1.770	19.69	2,588	2.04
H. 27	3,990	62.4	1.0797	19.2	16.80	1.16	88.0	1.824	17.19	2,225	1.81
B. 4578	5,800	65.3	1.0788	19.0	16.32	1.63	83.0	1.761	13.84	1,876	1.47

The average results of plant canes and first ratoons from Fields 1 and 10, Valsayn are given Table IX. Eight varieties have given better results as first ratoons than as plant canes; with the exception of M. 9003 all the varieties have done better than the Bourbon. The highest results were obtained from B. 6308, B. 156, Ba. 6032, B. 347, B. 208, B. 4934, D. 101, D. 116, M. 1287, and Badilla, all of which have given an indicated yield of sucrose in the juice of over 3 tons per acre.

Table X gives the average results for plant canes, first and second ratoons from Field 1, St. Augustine. The best results were obtained from B. 208, B. 156, B. 147, D. 141, and T. 75: these have given an indicated sucrose in the juice of over three tons per acre for the three years average. With the exception of Badilla, H. 27, and B. 4578, the second ratoons gave better results than the first.

TABLE IX.—AVERAGE RESULTS OF PLANT CANES AND FIRST RATOONS.

Fields 1 and 10, Valsayn.

CANE.	Sucrose in Juice—Tons per Acre.		
	Plant canes 1915, 19 months old.	1st Ratoons 1919, 12 months old.	Average for 2 years.
B. 6308	3.73	4.00	3.86
B. 156	4.54	2.73	3.64
Ba. 6032	3.87	2.39	3.43
B. 347	3.78	2.97	3.37
B. 208	3.99	2.71	3.35
B. 4934	2.96	3.63	3.29
D. 109	3.72	2.69	3.20
D. 116	3.98	2.22	3.10
*M. 1287	3.27	2.92	3.09
Badilla	3.11	2.98	3.04
*Striped	2.72	2.85	2.78
P. 55	2.73	2.79	2.76
T. 202	1.96	1.59	2.72
B. 576	2.65	2.75	2.70
B. 6348	2.64	2.71	2.67
T. 75	2.70	2.44	2.57
White Tanna	2.89	2.42	2.40
B N H. 02 (1)	2.83	1.76	2.32
H. ?	2.13	2.17	2.31
H. 227	3.34	1.27	2.30
B. 6150	2.61	1.77	2.20
B. 3122	2.60	1.75	2.17
B. 6835	2.31	1.98	2.15
B N H. 02 (5)	2.52	1.68	2.10
T. 39	2.15	1.93	2.04
H. 27	2.25	1.21	1.73
*B. 7482	1.12	2.25	1.68
Bourbon	2.16	1.09	1.62
*M. 9001	1.59	1.51	1.55

* Plants 17½ months and 1st Ratoons 11 months old when reaped.

TABLE X.—AVERAGE RESULTS OF PLANT CANES, FIRST AND SECOND RATOONS.

Field 1, St. Augustine.

CANE.	Sucrose in Juice—Tons per Acre.				
	Plant Canes 1917, 17 to 18 months old.	1st Ratoons 1918, 12 to 12½ months old.	2nd Ratoons 1919, 12 months old.	Average 2 years.	Average 3 years
H. 227	4 63	2 58	Cut for plants in September 1918.	3 60	...
B. 6835	4 08	2 82		3 45	...
H. ?	3 77	3 02		3 39	..
B. 3022	4 08	2 28		3 18	...
B. 347	3 56	2 75		3 15	...
B. 6450	3 96	2 27		3 11	...
B. 6808	4 14	1 92		3 03	...
H. 146	3 84	1 70		2 77	..
D. 4934	3 14	1 47		2 30	..
B. 6388	2 31	1 57		1 94	..
B. 208	4 30	2 79		...	3 33
B. 156	5 06	1 51		2 39	3 15
B. 147	4 07	2 51		2 79	3 12
D. 145	4 62	1 68		3 02	3 11
T. 75	3 93	2 18		3 09	3 07
Badilla	4 03	2 48		2 25	2 92
D. 109	3 97	1 68		2 75	2 80
D. 504	4 08	1 64		2 64	2 79
D. 116	3 64	1 87		2 59	2 70
B. 1753	3 30	2 13		2 63	2 69
T. 39	3 48	2 07		2 50	2 68
D. 3956	3 23	2 11		2 63	2 66
B. 3390	4 32	1 14		2 40	2 62
B. 7169	3 37	1 51		2 38	2 42
B. 376	2 77	1 76		2 70	2 41
T. 202	2 42	2 31		2 48	2 40
D. 2468	3 16	1 49		2 54	2 10
D. 366	3 74	1 16		2 15	2 35
Ba. 6032	2 48	1 04		...	2 33
Bourbon	3 25	1 70	2 04	...	2 33
D. 115	3 58	1 01	2 34	...	2 31
H. 27	3 17	1 96	1 81	...	2 31
B. 3412	3 52	1 01	2 40	...	2 31
B. 16332	3 29	1 07	2 09	...	2 13
B. 4578	2 99	1 74	1 47	...	2 07

RAINFALL, SUGAR PRODUCTION AND FROGHOPPER BLIGHT IN TRINIDAD.

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INTRODUCTION.

THE disease known as "Blight" or "Froghopper-blight" of Sugar Cane has been known in Trinidad for many years. The Froghopper (*Tomasaspis saccharina*) was first mentioned in 1889 but, even before the connection between the disease and this insect was recognised, old descriptions of injury leave little doubt that similar conditions were present many years before.

From the very earliest reports there has been a tendency to consider adverse weather conditions as one of the most important causes of blight; both want of rain, and excessive rainfall being suggested by various writers.

H. Cruger, in the first account of blight (written in 1868, published in 1892) considers one of the most important causes as "a want of rain at a certain period."

J. H. Hart in his "Report on Sugar Cane Blight" 1890, says that the canes recovered on the advent of suitable weather.

A. E. Collens in 1906, reporting on an outbreak at Harmony Hall, notes that "the dry season had been followed by heavy rains with rather long intervals of strong sun."

G. T. Fenwick (*Proc. Agr. Soc. Trinidad & Tobago*. IX. 1909, p. 558) writes "the attacks, whether from insect or fungus pests, were usually noticed to follow periods of abnormality in the seasons and generally disappeared when weather conditions were again normal."

P. L. Guppy in 1911 (*Bull. Dept. Agr.* X. 1911, p. 82) says "the extremely dry weather of this wet season has been particularly unfavourable to the growth of the cane and at the same time favourable to the rapid increase of the froghopper."

F. W. Ulrich in 1913 (*Circular No. 9, Board of Agr.* p. 30) says that "a long and severe dry season generally tends to cause a severe outbreak of froghoppers, whereas a mild one does not appear to produce such large numbers." He gives figures of the rainfall at Woodford Lodge Estate showing that in 1908 and 1912, both years of severe blight, the dry season was long and severe.

J. C. Kershaw, on the contrary, in 1914 (*Bull. Dept. Agr.* XIII. 1914, p. 48) says that "there is a common belief that in wet seasons the cane suffers less from froghoppers than in dry" but that "there is no real evidence that climatic conditions affected the incidence of froghoppers at all."

It is the object of the present report to inquire more fully into this supposed relation, and to see how far the various statements are justified by the experience of a longer series of years.

It is recognised that the rainfall may have effect in a number of different ways. Early rains in May will result in the broods being earlier; a sudden, as opposed to a gradual, start of the wet season will cause the broods to be more distinct; late rains in December and January will produce a partial fourth brood and may cause many eggs to hatch that would otherwise have passed over till the following wet season.

We are concerned here more particularly with the total amount of "blight" or "damage" in each year in relation to the rainfall.

The records of previous observers have been freely used and their contribution is gratefully acknowledged.

GENERAL RELATION BETWEEN RAINFALL AND CROP.

The strength of a chain is limited by its weakest link; in the same way the production of any crop on any particular piece of land is limited by the most unfavourable condition affecting that crop.

This condition may be one of many—temperature—rainfall—wind—chemical condition of soil—physical condition of soil—drainage, &c. Whatever the limiting or determining factor may be—and it may be different in different places or even in the same place in different years—the yield of the crop will directly follow changes in the limiting factor.

We should expect, then, to find the most distinct correlation between the sugar crop and rainfall in countries where the rainfall is low and has become a limiting factor.

Such a condition is found, for example, in the island of St. Croix where the rainfall is seldom above 40 inches. Fig. 1 shows the close relation that exists between the crop and the rainfall for the years 1891

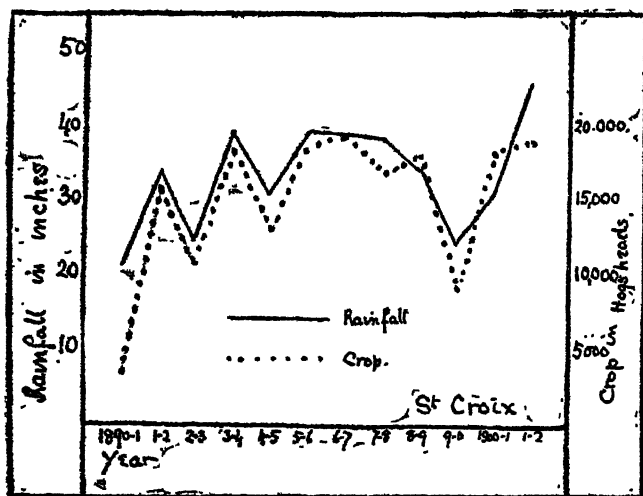


Fig. 1.

Fig. 1. Annual rainfall and sugar crop in St. Croix 1890-1902 showing close dependance of yield upon rainfall.

to 1902. The change of rainfall is so great that it is difficult to see a change in the crop.

In Barbados, where the rainfall is higher (4) to 5) in 1902, the correlation is less exact. Fig 2 shows the rainfall and total sugar crop of the island from 1870 to 1894. It will be seen how well the correlation

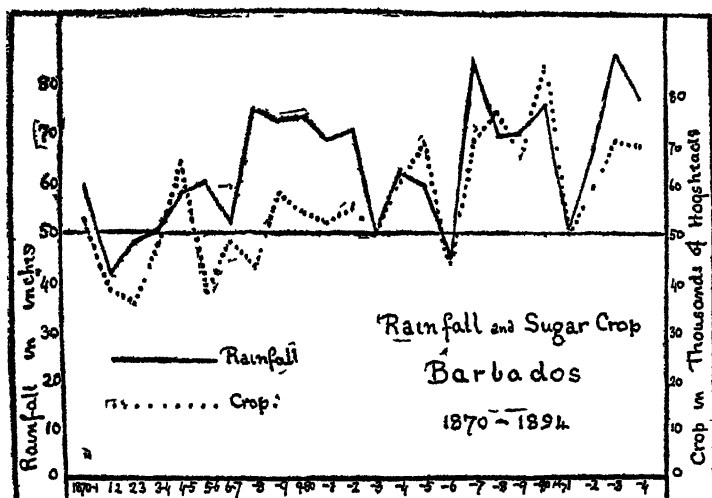


Fig. 2

Fig 2 - Annual rainfall and sugar crop of Barbados 1870-1894 showing that the effect of rainfall on the crop is most distinct in dry years.

here, the rainfall becomes a limiting factor in those years in which it is unusually low. Thus the years 1882-3, 1885, 6 and 1890-1, which were years of low rainfall, were also characterized by a disastrous drop in the sugar production.

In Trinidad the correlation is still less marked (Fig 3) for although the highest crops usually appear to have come in years of high total rainfall (1900-1, 1905-6, 1916-17) yet years of low rainfall may produce quite good crops (1903-4, 1908-9, 1911-14) often indeed well above years of much higher rainfall.

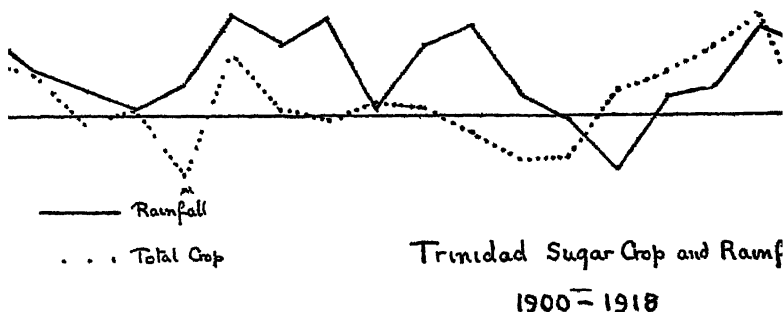


Fig. 3

The lack of relation between the total rainfall and the cane crop is shown still more distinctly if we compare the rainfall on an individual estate for a number of years with the yield per acre on

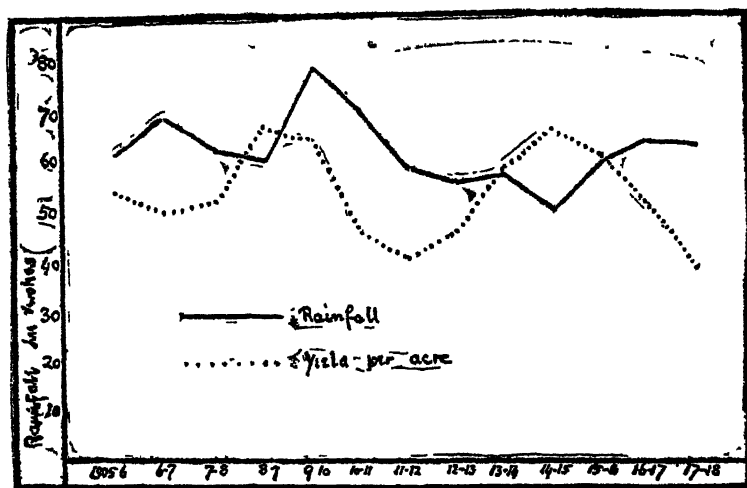


Fig. 4.

Fig. 4.—Annual rainfall and yield per acre on a Trinidad sugar estate, showing absence of distinct relation between the two.

the same estate for the corresponding year (Fig. 4). It will be seen that the highest yields per acre between 1905 and 1918 on this particular estate were obtained in years of low total rainfall (1908, 1914–15).

It is worthy of notice in this connection that the total rainfall of Trinidad is no greater than that of Barbados, yet in the latter island a low rainfall almost invariably produces a small crop. The explanation is found in the fact that, in spite of similar rainfall, Barbados is very much drier both in soil and atmosphere than Trinidad. The porous coral soil and rock in the former island allows the moisture to drain away more rapidly than do the heavier soils of the Trinidad canefields; and the more constant sea breezes and the lack of forest areas in Barbados prevent the formation of a stagnant moisture-laden atmosphere frequent over the canefields in Trinidad, where even in the middle of the dry season the cane plants are dripping with dew every morning. A Trinidad sugar estate with a rainfall of fifty inches in considerably moister, in practice, than a Barbados estate with the same rainfall.

In Trinidad, therefore, it appears that the total rainfall during the year is not an important determining factor in the sugar crop of the island. Even in dry years there is sufficient moisture present to produce a good crop, provided only that it is properly distributed throughout the year.

The years of wide spread blight during this period were 1906–7, 1907–8, 1911–12, 1912–13 and 1917–18. It will be seen also that these are not marked by any unusual excess or deficiency in the total rainfall, but may be years of high or low precipitation.

DISTRIBUTION OF RAINFALL DURING THE YEAR.

Even in countries like Trinidad, in which, as has been shown, the total rainfall during the year is not a limiting factor of the crop, that rainfall may be so distributed that there may be an excess at one period of the year and a deficiency at another.

The normal seasons in Trinidad consist of a dry season lasting usually from January to the middle of May, during which the rainfall is generally below three inches per month, and a wet season from June

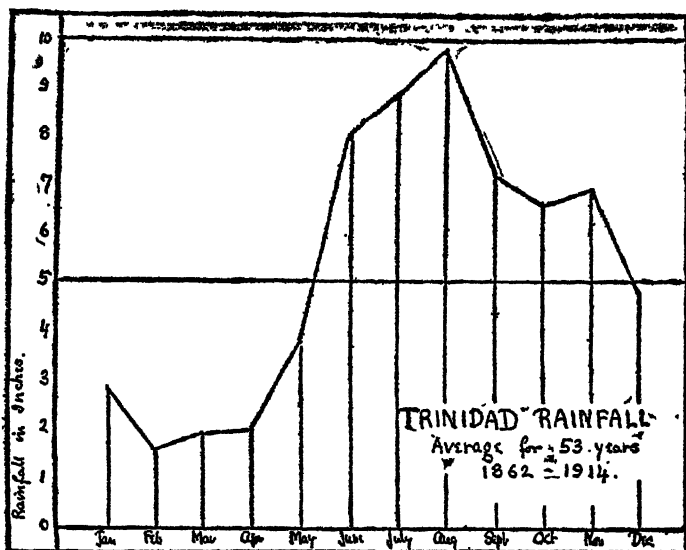


Fig. 5.

Fig. 5.—Monthly rainfall, Trinidad Botanic Gardens, average of fifty-three years.

to December in which the rainfall is usually over five inches per month. Fig. 5 shows the average monthly rainfall at the Botanic Gardens, and St. Clair Experiment Station, Port-of-Spain, for fifty-three years continuous observation. (1)

There is however one feature that is not so distinctly emphasised by the average curve as in reality. In nearly every year a dry period of longer or shorter duration occurs during August, September or October and is known locally as the "Indian Summer." An examination of the monthly records averaged in the above figures shows that this drop in the rainfall was distinct in about 85 out of the 53 years under consideration, the rainfall being below five inches four times in August, eight times in September and thirteen times in October.

This Indian Summer is one of the most important features of the rain distribution and has, as will be shown, a marked effect on the sugar crop and particularly on the prevalence of blight. Owing however

(1.) 1872 to 1899 at the Royal Botanic Gardens, and 1900 onwards at the closely adjacent St. Clair Experiment Station.

to it occurring sometimes in one month and sometimes in another its effect is almost eliminated in the process of averaging. It will be seen more distinctly in the graphs which follow, particularly in Figs. 7, 9, and 11.

The cane in Trinidad is usually planted from August to November ("wet season plants") or during the dry season ("crop plants") and is cut during the dry season of the following year. "Plant canes" (first cutting) have about eighteen months growth and "ratoon canes" (second and third crops) have twelve months growth.

The crop is therefore liable to be affected by the rainfall during the eighteen months previous to its cutting, which operation is carried out from February to May in normal seasons.

MONTHLY RAINFALL AND BLIGHT.

An attempt has been made to find the rainfall conditions associated with "blight" by plotting, in Figs. 6 and 7 the rainfall on one estate in five good years, in which few froghoppers were seen and little damage reported, and, on the other hand, in six years in which froghoppers were abundant and damage wide-spread.

An inspection brings out the following points of interest:—

GOOD YEARS.—(1909-10, 1910-11, 1914-15, 1915-16, 1916-17).

- (1.) Dry season usually shorter and less severe. January often wet (1910 exceptionally wet).
- (2.) July rainfall below 9·7 in all cases except one (1915).
- (3.) Indian Summer less marked. Rainfall only once below five inches in either September or October.

BAD YEARS.—(1906-7, 1907-8, 1911-12, 1912-13, 1917-18, 1918-19).

- (1.) Dry season usually longer and more severe (1916 exceptionally long and dry). January usually dry.
- (2.) July rainfall above 9·7 inches in all cases except one (1911, which had a wet June).
- (3.) Indian Summer distinct. Rainfall five inches or below in four years in September, and in five years in October. Never above five inches in both of these two months. Particularly low in October.

On the whole the years of wide spread blight are years of extreme contrast in rainfall characterised by alternations of excessively wet and dry weather.

In order to confirm the above results a comparison has next been made between the rainfall of four estates during 1916-17 when the damage due to blight was almost negligible (Fig. 8) and the rainfall

on the same four estates in the following year when the damage was very severe (Fig. 9).

It will be seen that the following points are again emphasised :—

GOOD YEAR, 1916 (Fig. 8).

- (1.) Dry season not severe. January wet.
- (2.) July unusually dry.
- (3.) Indian Summer distinct, but early and not severe.

BAD YEAR 1917 (Fig. 9).

- (1.) Dry season long (December to April) and rather severe.
- (2.) July unusually wet.
- (3.) Indian Summer later and unusually severe.

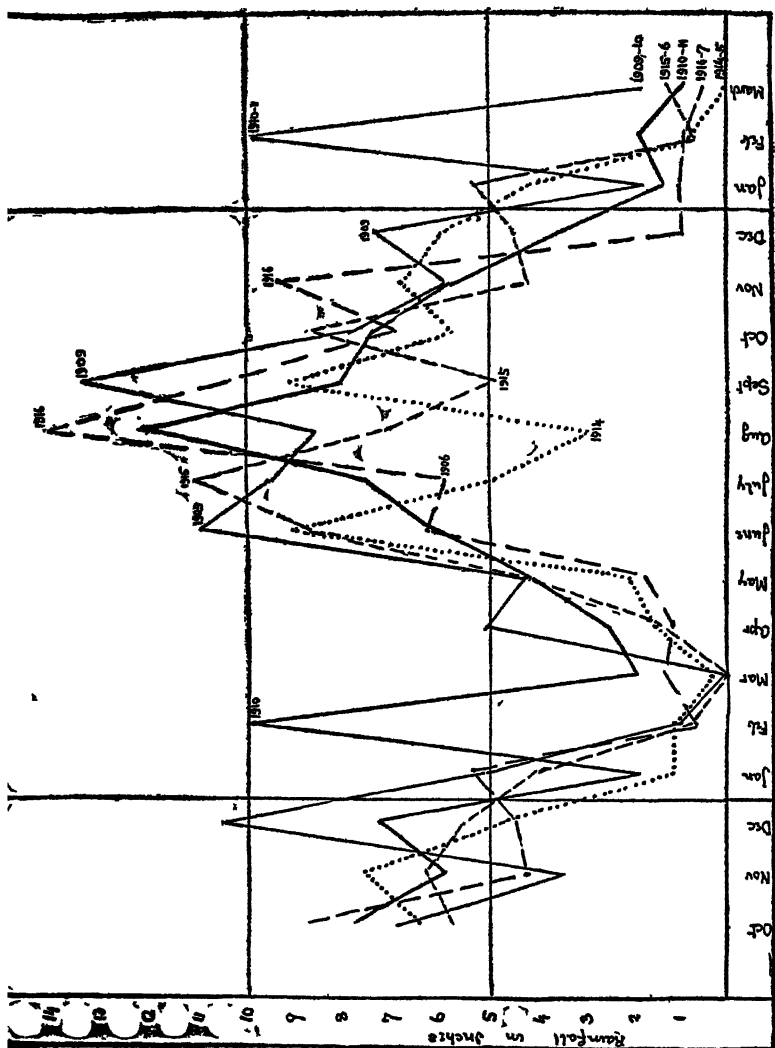
Once more the wide spread blight is associated with alternations of wet and dry weather and particularly with a late severe Indian Summer.

The two estates on which the rainfall remained low during November and December (Fig. 9) are both in the Southern half of the island and in both these the persistence of the damage after the froghopper had disappeared and the prevalence of root fungi was very marked.

Still further confirmation of the apparent relation is provided by a comparison of the rainfall on good and bad estates during the same year. Fig. 10 shows the rainfall during 1918 on three estates where practically no damage was reported. Fig. 11 shows, on the contrary, the rainfall on four estates on which the damage was more or less severe.

It will be seen that, once again, the wide spread damage is associated with low rainfall during September or October. The difference in the length of the dry season is less marked but just indicated, as it will be seen that all the good estates and only one bad estate had a January rainfall of over five inches.

The effect of the rainfall during July is not distinct but the importance of the Indian Summer drought is still further emphasised when it is seen that the two estates with the lowest rainfall during September were also those on which the damage was most severe.



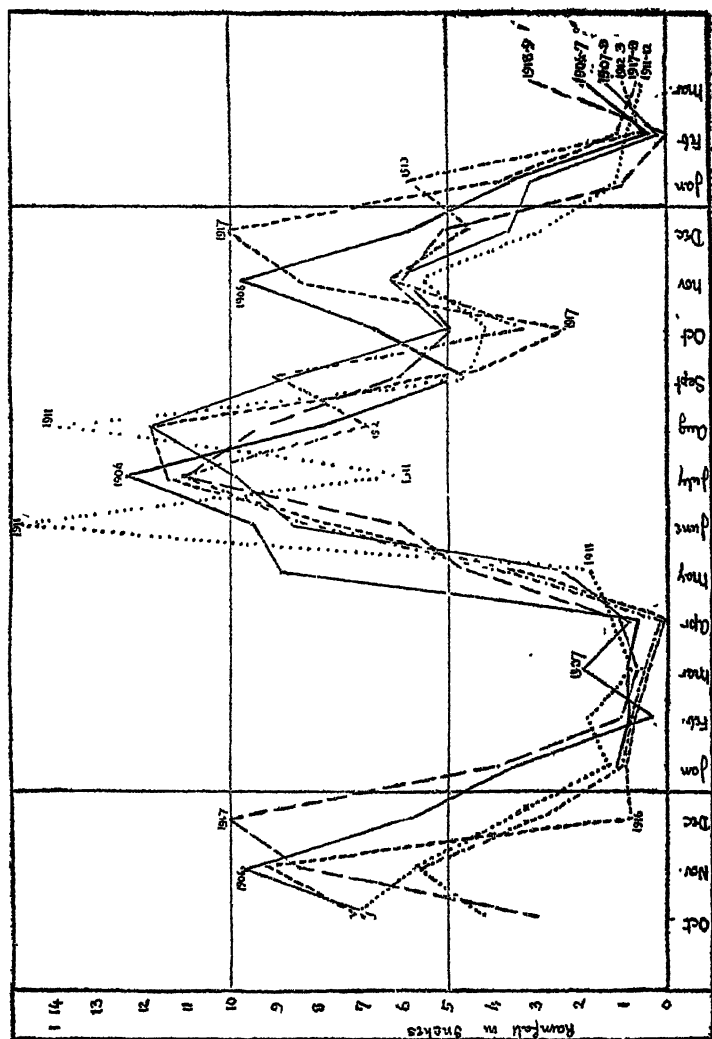
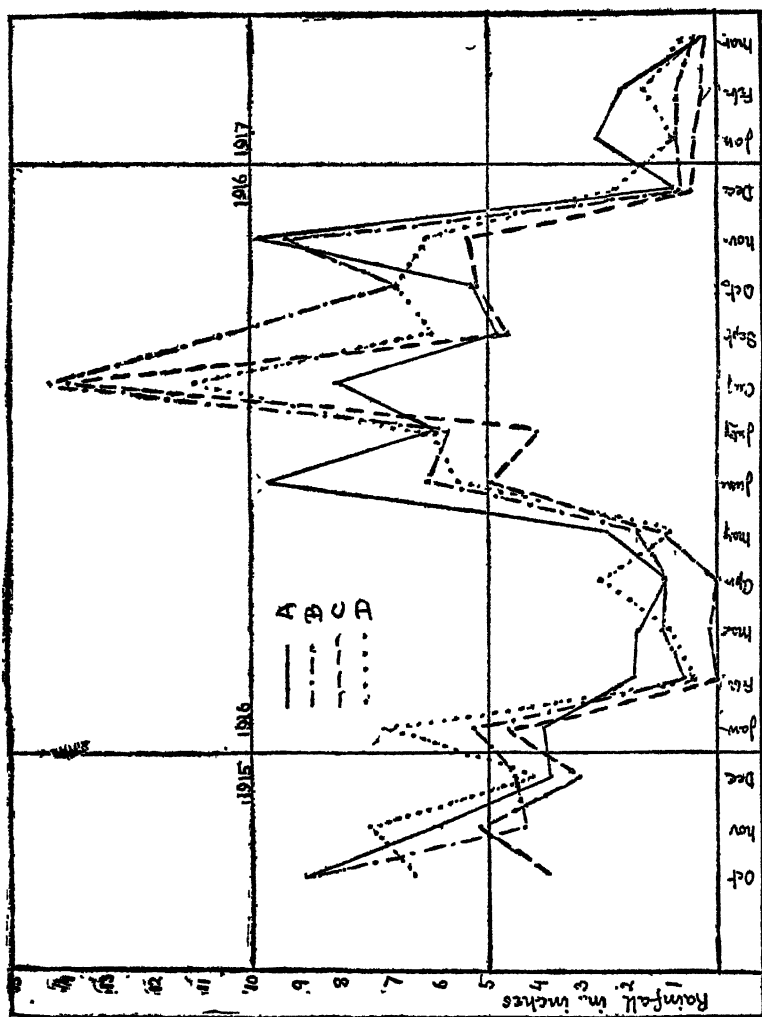
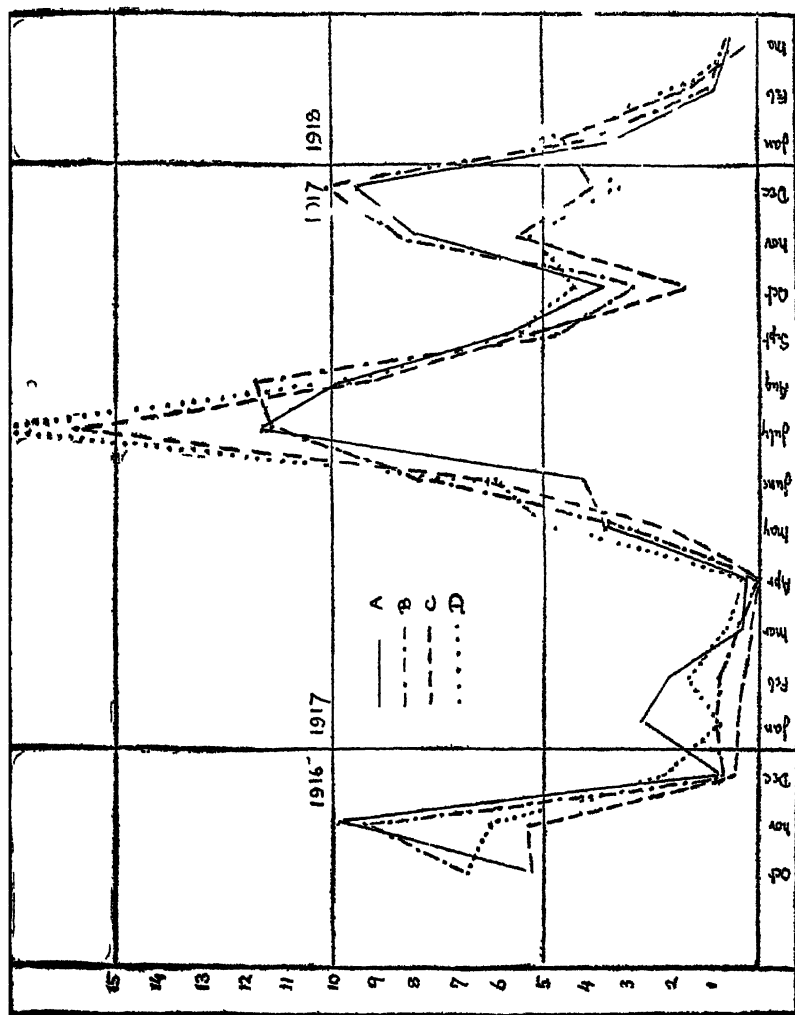


Fig. 7.

Fig. 7. Monthly rainfall on the same estate during 17 years of white fly and blight. Note the marked drop in all cases in September or October at the "Indian Summer" (see p. 14.6).





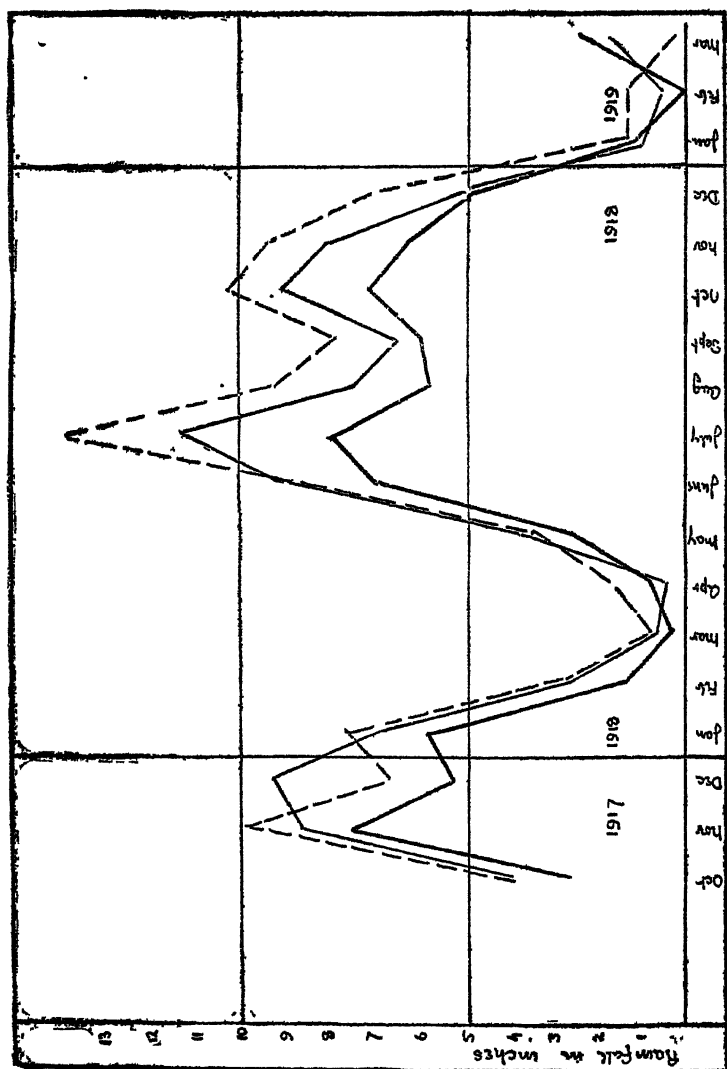


Fig. 10.

Fig. 10.—Monthly rainfall during 1918 19 on the estates where no damage was reported (c.p. Fig. 11).

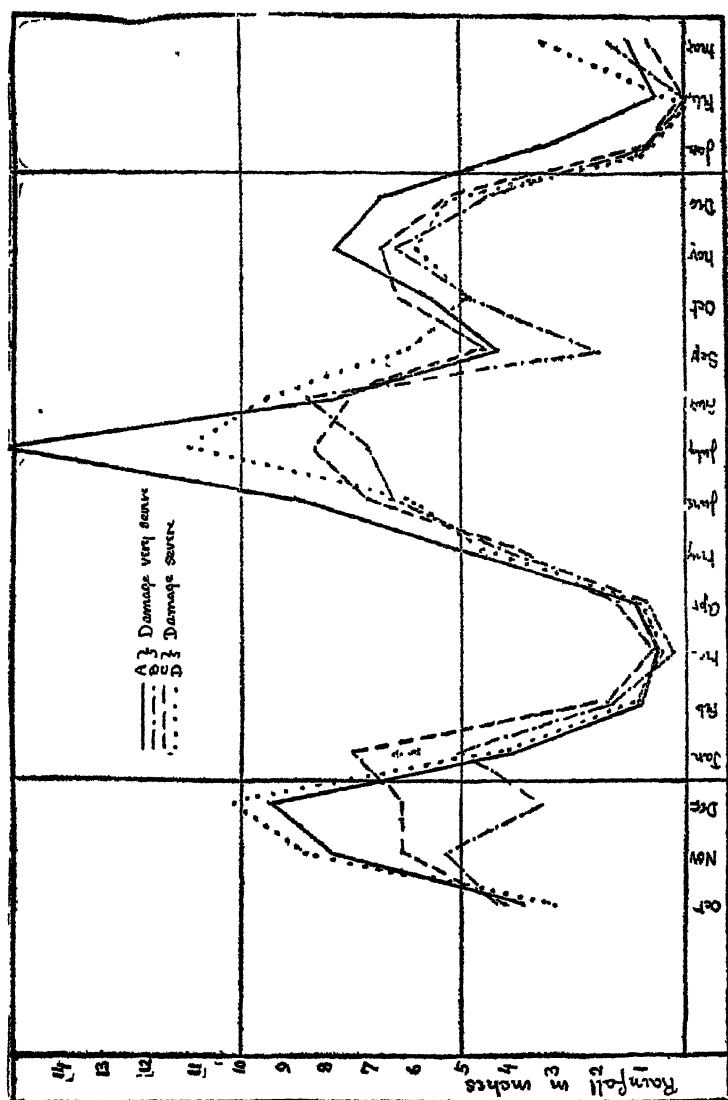


Fig 11 — Monthly rainfall during the same period on four estates, where damage was more or less severe. Note it in the more severe "Indian Summer" drought in September (c.p. Fig 9)

DISCUSSION.

It will be seen that there is strong evidence that blight is more wide-spread in years or localities with unusual alternations of wet and dry periods and particularly when the Indian Summer dry period in September or October is well marked.

The relation of this fact to the general problem of understanding and controlling blight will be dealt with more fully later in a report which will take into consideration other associated conditions. The object of the present report is chiefly to give accurate data for future discussion.

The following suggestions however, arise from a study of this relation.

The critical period at which the canes seem to need moisture to prevent blight is in September or October. This is in most years just *after* the second brood of froghoppers. Drought at this time cannot affect the number of froghoppers of the earlier broods. It may affect the numbers of the third brood (possibly by preventing the spread of the green muscardine fungus) and so increase the damage later in the year. But probably the most important effect is that it prevents the recovery of the canes to which damage has been done by the first two broods, and in those frequent cases where root fungi are also present, it works on an already diseased root system and causes the more or less complete drying up of the canes.

The fact that this important determining condition occurs *after* the second brood is further confirmation of the position to which we are driven by other considerations also—namely, *that the actual number of froghoppers present in a field, although naturally not to be ignored, is often of less practical importance than the general ability of the field of canes to withstand the damage.*

In a previous report on the relation of Root Fungi to Blight (*Bull. Dept. Agr.* XVIII. 1919. p. 52-6) attention has been drawn to the same point and figures have been given showing the number of froghoppers that may be present in a field without causing permanent injury, and also showing that many fields have been destroyed with but a small proportion of this number.

It may be argued that the rainfall is a condition over which the planter has no control. This is true of the actual rain which reaches the ground, but the proportion of this which becomes available to the plant depends very largely on agricultural operations.

We have seen that low rainfall, and to a less extent high rainfall, are both conducive to blight. There is one agricultural process which will reduce both evils and that is *Drainage*.

Good drainage carries off surplus water in time of floods and also (and this effect is less generally realised) provides more *available* water in time of drought. Drainage lowers the water level in the soil, and thereby makes a deeper layer of the soil available for the root system of the plant, from which more moisture can be extracted in time of drought.

It is common knowledge that plants in a water-logged soil are the first to suffer from a dry spell, for although the moisture may be present only a few inches away, the root system of the plant, confined by lack of air to the top layer of the soil, has not enough reserve strength to withstand the sudden adverse conditions and cannot reach the necessary moisture.

SUMMARY.

(1.) Alternation of wet and dry periods during the growth of the sugar cane is shown to be an important factor in determining the prevalence of "blight."

(2.) A long dry season followed by unusually heavy rains in June or July, is frequently connected with wide-spread blight.

(3.) The most important climatic condition however, appears to be the severity of the "Indian Summer," a dry period in September or October. A severe Indian Summer is a general condition both of localities damaged by blight in one year and of years of wide-spread blight in one locality.

(4.) Blight could be reduced, irrespective of its first cause, by getting the field in a condition to lessen the effects of excessive moisture and drought.

(5.) Better drainage is the obvious agricultural method that will help to bring about these conditions.

August, 1919.

FOOD CROPS.

EXPERIMENTS ON YAM CULTIVATION 1918-19.

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and L. A. BRUNTON,

Assistant Superintendent of Field Experiments.

DURING the season of 1918-19, the previous year's experiments on yam cultivation at St. Augustine Experiment Station were repeated and two additional experiments added viz:—(a) staking the vine *versus* non-staking and (b) different size of plants. The results obtained were as follows.

Trenches and holes were dug eighteen inches deep and half the width of the distances apart. For example trenches four and three feet apart were dug two feet and eighteen inches wide respectively; holes four feet by three feet and four feet by two feet were dug two feet by eighteen inches and two feet by one foot wide. The weight of the "plants" was approximately a quarter of a pound, unless otherwise specified. The plants were put into the ground between June 10 and 14, 1918, and reaped between February 17 and March 20, 1919, *i.e.*, eight to nine months later. All the experiments were made with the Barbados Lisbon variety and the results given are the average of duplicate plots.

VARIETIES.

Three varieties, the Barbados Lisbon, Horn and Red yams were tried on duplicate plots. The following results were obtained:—

Variety.	Area planted.	PER ACRE.	
		Yield.	Value of crop at 3s. a lb.
	Sq. ft.	Tons.	\$ c.
Lisbon ...	450	15.25	1,024.80
Red ...	450	9.88	626.97
Horn ...	450	4.67	313.82

The yield of the Horn yam is disappointing and practically ten tons less per acre than that of the previous year, whereas the yield from the Lisbon and Red yams was three and two and a half tons less respectively. The Lisbon has again proved the most prolific yielder, having given 5.88 tons per acre more than the Red yam.

SELECTION OF PLANTS.

The experiment to ascertain whether it was preferable to use the top, centre or bottom portions of the tubers for planting purposes was again carried out.

The plants were put in prepared holes, three feet by three apart with the following results :—

Description.			Area planted.	Yield per acre.
Top	...	...	450	11.32
Centre	...	...	450	11.15
Bottom	...	...	450	12.01

As in the previous year the above results show that the difference is very small and within the limits of experimental error; it can be safely concluded therefore that there is no special advantage in selecting any special part of the tubers for planting.

SIZE OF PLANTS.

With a view of ascertaining the correctness of the statement made by several interested in yam cultivation "that a large plant gives a larger yield than a small plant" the following experiment was carried out.

Holes were dug three feet apart, eighteen inches deep and filled in the usual way. Duplicate plots were planted with plants a quarter, a half and one pound each respectively and the following results were obtained :—

Size of plants.	Area planted.	PER ACRE.		
		Yield.	Cost of cultivation plants and reaping.	Net Profit.
	Sq. feet.	Tons.	\$ c.	\$ c.
One-quarter pound ...	450	13.26	252.15	638.92
One-half pound .	450	12.23	288.45	533.41
One pound ..	450	13.35	361.05	536.07

The results are not conclusive as far as the yield is concerned, but they show that there is no advantage to be gained in using larger size plants than a quarter of a pound. The extra value of the half and one pound plants was \$36.80 and \$108.90 per acre respectively.

METHOD OF PLANTING

Several points arise as regards the method of planting such as :—

- (1.) Is it more profitable to plant in holes or in trenches ?
- (2.) What is the best planting distance ?
- (3.) Is it necessary to have large holes filled with trash or manure ?
- (4.) Is there any advantage in staking the vine ?

For these experiments trenches were dug four and three feet apart and planted at distances of one foot, eighteen inches, two and three feet apart respectively. Holes were dug four feet by three feet, four

feet by two feet, three feet by three feet, and three feet by two feet respectively. Another set of holes were dug two feet by eighteen inches wide and eighteen inches square but only eight inches deep at a distance of four feet by three feet and three feet by three feet apart; trash and manure were applied to one-half of these holes as is usually done, whereas no trash or manure was put in the others which were simply refilled with loose earth from around and the soil drawn up in a hill over the holes.

The results obtained are given below;—

Plot.	Area planted.	Treatment.	PER ACRE.		
			Yield.	Cost of cultivation, plants and reaping.	Net profit.
	Sq. ft.		Tons.	\$ c.	\$ c.
1	560	Holes 8 inches deep 4 ft. x 3 ft. without trash or manure ...	6.94	158 58	307 70
2	560	Holes 8 inches deep 4 ft. x 3 ft. with trash and manure ...	8.47	179 87	389 31
3	420	Holes 8 inches deep 3 ft. x 3 ft. without trash or manure ...	9.49	187 03	450 70
4	420	Holes 8 inches deep 2 ft. x 3 ft. with trash and manure ...	10.18	211 81	472 29
5	900	Holes 18 inches deep 3 ft. x 2 ft. ...	14.15	308 44	642 44
6	900	Holes 18 inches deep 3 ft. x 3 ft. ...	14.56	232 15	726 28
7	1,200	Holes 18 inches deep 4 ft. x 2 ft. ...	9.32	279 68	346 02
8	1,200	Holes 18 inches deep 4 ft. x 3 ft. ...	9.67	228 27	421 55
9	1,200	Trenches 4 ft. apart planted 18 inches apart ...	12 05	303 01	506 75
10	1,200	Trenches 4 ft. apart planted 2 ft. apart ...	10.31	284 15	406 70
11	1,200	Trenches 4 ft. apart planted 3 ft. apart ...	8.15	273 02	274 06
12	900	Trenches 3 ft. apart planted 18 inches apart ...	14.04	336 31	647 50
13	900	Trenches 3 ft. apart planted 1 ft. apart ...	15.32	376 20	653 21
14	450	Trenches 3 ft. apart planted 1 ft. apart unstaked ...	16.03	337 83	739 39
15	450	Trenches 3 ft. apart planted 18 inches apart unstaked ...	10.58	297 85	413 13

Although the soil at St. Augustine is a fairly loose sandy loam it was found last year more profitable to have deep holes *i.e.* eighteen inches than shallow holes *i.e.* eight inches deep, notwithstanding the higher cost of preparing the deep holes. The experiment was repeated this year and similar results were obtained as can be seen by comparing the results of plots 1 and 2 with those of plot 8, and plots 3 and 4 with plot 6. Deep holes four feet by three feet and three feet by three feet gave a net profit of \$421.55 and \$726.28 per acre against \$389.31 and \$472.29 respectively from the shallow holes. It will also be seen that it is more profitable to fill the holes with trash and manure, as not only has a larger yield been obtained but the value of the increased crop is more than sufficient to pay for extra cost of procuring and filling the holes with trash and manure, *vide* plots 1 and 2, 3 and 4.

As regards the planting distance the results this year as last show that a larger yield is obtained with close planting. Holes four feet by two feet and four feet by three feet gave yields of 9.32 and 9.67 tons as against 14.15 and 14.56 tons per acre from holes three feet by two feet and three by three feet respectively; a larger profit per acre has also been obtained from the closer planting. Similarly the yield from trenches four feet apart planted at distances of three, two and one and a half feet was 8.15, 10.34 and 12.05 tons as against 14.64 and 15.32 tons per acre from trenches three feet apart planted at distances of one foot and eighteen inches apart. It should be mentioned however, that it has been found awkward to make holes three feet, by two feet and four feet by two feet apart, the nearest convenient distance at which these can be made is three feet by three feet, moreover it is with holes at this distance that the best results have been obtained. The best distance for trenches is three feet apart and the plants may be put at two, one and a half and even one foot apart. The extra value of the plants and planting one foot apart in trenches three feet apart is \$89.38 more than when the plants are put in eighteen inches apart and an increased yield of 12 cwt. per acre would be required to cover this extra cost.

The question as to whether trenching is more profitable than holing is not so easily answered. Trenching is more expensive than holing but as it permits of closer planting, a higher yield is usually obtained *vide* plots 12 and 13 as compared with plots 5 and 6, also plots 9, 10 and 11 compared with plots 7 and 8. With trenching the land is better prepared for subsequent crops, especially if the untrenched portion of the first year is worked up for the second year. Holes three feet by two feet and three feet by three feet gave a profit of \$642.44 and \$726.28 per acre respectively; trenches three feet apart planted at distances of one foot and eighteen inches gave a profit of \$653.21 and \$647.50 per acre respectively.

The usual practice in Trinidad is to stake the yam vines after they have grown from three to four feet long and the opinion has been expressed by several that staking is essential to obtain a large crop, the idea being that with our heavy rainfall and damp climate the vines would rot especially if injured when weeding or moulting the plants. With the object of ascertaining the correctness of this opinion two plots have been tried this year without staking in trenches three feet apart planted at distances of one foot and eighteen inches. The results are shown under plots 14 and 15 as compared with plots 12 and 13 where the vines were staked. The unstaked plots have given a yield of 16.03 and 10.58 tons as against 15.32 and 14.64 tons per acre from the staked plots. Although the results of this first experiment are not conclusive a higher yield having been obtained in one plot from the unstaked and in the other from the staked plot—they tend to show that as large a yield may be obtained without staking as from staking the vines. As the cost of staking is by no means negligible it may be found in subsequent experiments to be more profitable to dispense with staking.

AVERAGE RETURNS PER ACRE.

The total area under jam cultivation at St. Augustine Experiment Station during 1918 was 20,735 sq. ft. or nearly half an acre, from which 11,613 lb. of jams were reaped *i.e.* 10.86 tons per acre.

The value of the crop at three cents per pound works out at \$730.14 and the total cost of cultivation including the purchase of plants was \$267.83 leaving a profit of \$462.31 per acre. The cost of cultivation may appear somewhat high but it must be borne in mind that it is the average for several small plots under experiment, which naturally cost more than under ordinary conditions.

METEOROLOGY.

RAINFALL RETURNS.—JULY TO SEPTEMBER, 1919.

Stations.	July.	August.	Sept.	January to Sept., 1919.	January to Sept., 1918.
<i>North-west District.</i>					
St. Clair—Royal Botanic Gardens ...	5.17	6.82	7.96	34.30	46.11
Port-of-Spain—Colonial Hospital ...	4.07	4.19	3.93	25.18	37.13
„ Royal Gaol ...	4.80	6.24	7.11	33.28	42.65
„ Constabulary Headquarters ...	8.29	9.14	8.65	30.63	35.39
St. Ann's—Reservoir ...	8.13	8.27	8.58	40.51	61.15
Maraval—	5.39	9.19	6.37	34.42	53.04
„ Constabulary Station ...	6.32	12.83	6.24	42.10	57.05
Diego Martin—Constabulary Station ...	4.97	14.72	8.13	47.71	64.59
„ Waterworks ...	6.07	10.77	6.37	40.58	53.56
„ River estate ...	5.84	11.25	6.63	40.20	54.43
Fort George Signal Station ...	5.36	6.05	11.03	37.73	50.56
North Post ...	4.69	11.19	4.44	33.41	...
Carriage Constabulary Station ...	7.05	6.41	8.97	39.57	55.69
Carriera Island Convict Depot ...	2.79	3.33	2.19	14.90	15.60
Chacachacare Lighthouse ...	5.12	7.66	5.84	31.74	39.78
<i>Santa Cruz—Maracas District.</i>					
Santa Cruz—Constabulary Station ...	6.08	12.82	4.69	43.33	61.75
St. Joseph—Government Farm ...	5.55	9.34	5.07	36.75	44.30
„ Constabulary Station ...	5.32	7.78	4.61	26.64	35.41
Tunapuna—St. Augustine estate ...	5.59	8.16	4.01	33.44	42.93
Maracas—Government School ...	6.23	11.06	4.77	41.86	...
„ Orinola estate ...	5.54	7.96	4.59	35.00	55.61
„ San José estate ...	6.69	9.68	3.50	39.03	47.80
Caua—Wardour estate ...	6.98	7.83	3.39	33.21	46.93
<i>West Central District.</i>					
Caroni—Frederick estate ...	8.37	6.78	6.73	45.45	47.88
Chaguanas—Constabulary Station ...	7.07	7.20	3.50	36.09	42.53
„ Woodford Lodge estate ...	6.09	6.75	2.00	34.07	41.68
Carapichaima—Waterloo estate ...	8.26	6.03	8.73	43.09	49.40
„ McBean Cacao estate ...	7.43	6.67	4.10	37.52	45.79
„ Friendship Hall estate ...	7.98	6.74	4.09	37.68	...
Couva—Exchange estate ...	7.29	4.04	4.27	32.46	36.10
„ Brechin Castle estate ...	10.08	6.88	5.51	40.87	43.87
„ Perseverance ...	8.07	3.22	5.71	32.43	40.15
„ Camden ...	...	...	...	...	...
„ Milton ...	9.99	9.07	4.59	43.37	46.87
„ Spring ...	6.39	6.65	5.47	38.05	44.05
„ Constabulary Station ...	10.64	4.61	6.03	41.62	39.26
„ Esperanza estate ...	7.18	9.06	4.24	36.11	38.84
<i>Montserrat District.</i>					
Brasso-Piedra—Mamoral estate ...	10.12	11.75	7.03	50.82	62.31
„ La Marianna estate ...	8.89	10.02	6.76	51.42	58.85
Montserrat—Constabulary Station ...	7.16	7.11	4.86	42.24	49.98
Brasso—La Vega estate ...	9.08	9.90	6.21	51.13	58.00
<i>Arima District.</i>					
Arima—Warden's Office ...	11.12	10.36	4.41	46.30	60.24
„ Torrecilla estate ...	12.18	13.16	6.76	57.57	69.30
„ Verdant Vale estate ...	9.87	12.09	9.05	55.51	50.76
San Rafael—Constabulary Station ...	11.11	10.86	6.20	59.61	63.53
Guanapo—Talparo estate ...	9.75	10.49	5.28	54.67	66.43
„ El Quemado Estate ...	11.06	11.93	6.76	59.71	72.10
Tamana—Sta. Marta estate ...	12.03	14.80	8.62	71.29	78.10
„ La Carona estate ...	12.15	12.96	7.00	64.04	68.98
<i>San Fernando & Princes Town District.</i>					
Claxton's Bay—Forres Park estate ...	4.28	7.40	2.98	29.42	39.14
Pointe-à-Pierre—Bonne Aventure estate ...	5.57	6.81	2.12	29.52	48.09
„ Concord estate ...	5.07	6.51	2.18	28.97	51.88
„ Plein Palais estate ...	3.93	7.27	2.75	30.78	43.48
Napierima—Pictou estate ...	4.34	11.96	5.14	41.05	44.03
„ Usine St. Madeleine estate ...	6.62	10.15	3.49	34.77	42.61
„ La Portunée estate ...	4.58	6.47	3.46	28.66	36.70
„ Tarouba estate ...	4.07	9.16	2.89	29.30	32.06

RAINFALL RETURNS—JULY TO SEPT., 1919.—CONTINUED.

Stations.	July.	August.	Sept.	January to Sept., 1919.	January to Sept., 1918.
<i>San Fernando and Princes Town District.—(Contd.)</i>					
Naparima—Palmiste estate ...	4.96	11.31	5.54	42.34	18.11
„ Lewisville House ...	6.70	9.69	2.54	41.41	52.61
„ Hermitage estate ...	4.51	10.43	4.98	45.39	42.36
„ Petit Morne estate ...	5.03	9.00	4.27	35.20	37.03
Princes Town—Craignish estate ...	5.55	7.10	4.14	38.51	52.29
„ Cedar Hill estate ...	5.06	9.73	3.91	39.79	48.50
„ Williamsville estate ...	6.01	7.24	3.80	38.61	50.90
„ Esmeralda estate ...	7.78	11.14	4.21	60.04	63.68
„ New Grant estate ...	6.04	9.04	4.91	45.19	61.29
„ Constabulary Station ...	5.45	6.07	2.75	30.69	39.14
„ Hindustan estate ...	5.23	7.33	3.49	37.58	48.09
„ La Retraite estate ...	7.46	10.81	6.48	55.31	77.53
„ Malgretoute estate ...	5.14	8.22	3.36	33.25	55.53
Friendship & Ben Lomond estates ...	...	...	...	...	52.03
Los Naranjos estate ...	6.94	9.49	5.12	48.70	48.92
Poole—El Rosario estate ...	5.88	12.34	5.11	47.24	66.98
<i>South-west District.</i>					
Oropuche—Constabulary Station ...	1.71	3.93	1.75	15.60	48.29
„ Pluck estate ...	4.56	7.62	3.11	35.26	...
Siparia—Constabulary Station ...	4.50	9.67	2.50	30.00	52.15
„ Alta Gracia estate ...	5.79	10.11	4.06	41.44	57.91
Guapo—Adventure estate ...	3.99	5.55	4.21	28.52	45.33
Point Fortin—Constabulary Station ...	6.96	8.45	5.49	41.76	52.49
Erin—La Ressource estate ...	2.21	6.68	1.83	...	32.76
La Union estate ...	3.97	8.78	3.19	31.96	37.39
Industry estate ...	4.70	9.77	2.28	32.34	41.44
Cedros—La Retraite estate ...	8.79	9.87	5.04	45.46	51.63
„ Beaulieu estate ...	4.82	6.35	1.14	31.97	...
„ Perseverance estate ...	5.04	7.35	2.24	33.55	37.97
„ St. Marie estate ...	6.69	7.84	2.61	36.52	40.51
„ Constabulary Station ...	5.15	7.60	2.95	35.73	37.48
„ St. Quintin estate ...	5.83	9.65	2.08	35.56	38.32
Icacos—Constance estate ...	5.14	5.29	...	...	101.95
Irois—Government School ...	7.89	8.87	5.97	42.41	44.09
<i>South Coast.</i>					
Moruga—Constabulary Station ...	5.48	9.70	5.00	43.14	42.01
<i>East Coast.</i>					
Matura—La Juanita estate ...	9.55	17.03	8.11	65.70	76.60
Manzanilla—Constabulary Station ...	5.96	18.87	4.47	37.41	70.02
„ Indrasan estate ...	9.14	...	...	...	74.76
Sangre Grande—New Lands estate ...	12.06	10.76	6.43	65.96	77.89
„ Evasdale estate ...	12.05	14.52	5.08	65.36	75.64
„ Grosvenor estate ...	11.73	17.10	6.72	67.70	76.06
„ El Recundo estate ...	10.03	16.13	5.92	59.42	67.21
„ San Francisco estate ...	11.90	17.02	7.40	70.07	72.60
Mayaro—Constabulary Station ...	5.47	9.25	4.96	41.16	59.85
<i>North Coast.</i>					
Blanchisseuse—Constabulary Station ...	7.38	10.58	4.90	47.27	66.41
Grande Rivière—Mon Plaisir estate ...	9.74	20.08	10.12	70.11	78.79
Toco—Aragua House ...	7.62	15.49	8.45	53.31	62.77
„ Constabulary Station ...	6.94	8.16	6.38	42.17	55.11
Point Galera—Light House ...	...	...	...	...	48.31
<i>Tobago.</i>					
Tobago—Hermitage estate ...	7.93	16.12	12.68	65.14	...
„ King's Llay „ ...	7.32	10.34	8.66	53.92	58.12
„ Roxburgh „ ...	9.51	10.15	10.59	57.74	...
„ Lure estate ...	...	...	...	...	92.42
„ Botanic Station ...	8.53	8.02	6.78	41.61	51.96
„ Government Farm ...	6.22	7.50	5.72	33.91	36.61
„ Lowlands estate
„ Friendship „	44.19
„ Riversdale „	49.05
„ Bon Accord „ ...	5.14	10.29	6.58	33.46	...

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE TRINIDAD & TOBAGO.

Issued by the Department and Board of Agriculture.



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W. G. Freeman.

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under Ordinance No. 30, 1915.

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Trinidad *Date of Registration.*

Diego Martin	October	12, 1916.
Lothians	April	4, 1919.
Malgretout	...	...	April	30, 1919.
Petit Morne	...	..	April	30, 1919.
Union Hall	...	...	April	30, 1919.
Malgretout East Indian	...	...	May	26, 1919.
Pieton	..	...	May	30, 1919.
Petit Morne (Palmyra)...	...	...	June	18, 1919.
Tarouba (Ne Plus Ultra)	...	...	June	18, 1919.
Union-Marabella	...	...	July	10, 1919.
Harmony Hall	...	...	July	10, 1919.
Williamsville East Indian	...	...	July	10, 1919.
Indian Walk	...	...	August	19, 1919.
Williamsville, West Indian	...	...	September	11, 1919.
Plein Palais	...	...	November	9, 1919.
Lengua	...	...	November	9, 1919.

Tobago.

Pembroke	...	...	June	18, 1917.
Scarborough	...	..	April	11, 1918.
Delaford	...	...	August	26, 1918.
Mason Hall	December	16, 1918.
Moriah	December	16, 1918.
Charlotteville	February	4, 1919.

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Reference Library.

THIS Library can be consulted at the Head Office of the Department, St. Clair Experiment Station. It contains standard works on General Agriculture, Horticulture, Botany, etc., and books and periodicals dealing with Cacao, Sugar, Coconuts, Rubber, Cotton, Corn, Fruit, Tobacco, and other crops.

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Department of Agriculture.

GOVERNMENT STUD ANIMALS.

THE following are the arrangements for November and December with regard to Stud animals of the Government Farms in Trinidad and Tobago.

Stallions.

<i>Name.</i>	<i>Class.</i>	<i>Where standing for Service.</i>	<i>Fee.</i>	<i>Groom's Fee.</i>
QUICKMATCH.	Thorough-bred	...Govt. Farm Trinidad...	\$ 10.00	60c.
NELSWEEP...	Thorough-bred	...Govt. Farm ,, ...	10.00	60c.
SIR HOBBS...	Thorough-bred Hackney.	Govt. Farm ,, ...	5.00	60c.
RILLINGTON SPARTAN.	Cleveland Bay.	Govt. Farm ,, ...	5.00	60c.
MARAT	...Thorough-bred	...Roxburgh, Tobago ...	5.00	60c.

Jack Donkeys.

Monarch	...American Donkey	...Govt. Farm, Trinidad...	\$ 5.00	60c.
President	... Do. do.	...Govt. Farm, Tobago...	5.00	60c.
Barbados Joe	...	...Govt. Farm, Trinidad...	1.20	60c.

Bulls.

A.—AT GOVERNMENT FARMS.

TRINIDAD.			TOBAGO.	
<i>Class.</i>		<i>Fee.</i>	<i>Class.</i>	<i>Fee.</i>
2 Pure-bred Zebu	...	\$ 1.20c.	1 Pure-bred Zebu	...\$1.00
1 " Jersey	...	2.40c.	1 Half-bred Guernsey	... 1.00
8 Half-bred Red Poll	...	1.20c.		
1 Half-bred Holstein	...	1.20c.		
1 Half-bred Shorthorn	...	1.20c.		

B.—AT PUBLIC PASTURES OR ESTATES.

<i>Place.</i>	<i>Class.</i>
Queen's Park Savannah	1 Half-bred Shorthorn; 1 Half-bred Holstein.
Mucurapo Pasture	1 Half-bred Shorthorn; 1 Half-bred Guernsey.
St. Clair Expt. Station	1 Half-bred Holstein.
St. Augustine Estate	2 Half-bred Holstein; 1 Half-bred Guernsey.
River Estate	1 Half-bred Zebu;
San Fernando	1 Pure-bred Holstein; 1 Half-bred Jersey.
Harmony Hall Estate	1 Pure-bred Shorthorn.
Arima	1 Half-bred Jersey.
Tobago, Friendship Est.	1 Half-bred Holstein.

Pigs.

AT GOVERNMENT FARM, TRINIDAD.

White Yorkshire, Poland China, Berkshire, Tamworth \$1.00, and Attendant's Fee 25c.

AT GOVERNMENT FARM, TOBAGO.

BerkshireFee 50c.

AT ST. CLAIR EXPERIMENT STATION.

Berkshire\$1.00 and Attendant's Fee 25c.

POULTRY.

GOVERNMENT FARM, TRINIDAD.

Eggs of Barred Plymouth Rocks, Rhode Island Reds,

White Leghorns\$1.00 per doz.
Great Kind Pigeons40c. and 60c. per pair.

GOVERNMENT FARM, TOBAGO.

Eggs of Plymouth Rocks, Black Minorcas, Rhode Island Reds 48c. per doz.
Also Cocks and Pullets of Plymouth Rocks and Rhode Island Reds.

Department of Agriculture.

NURSERY STOCK.

Cacao, Limes and any other plants required in large quantities for delivery for early planting in 1920 should be ordered now; address letters to the Superintendent, St. Clair Experiment Station, or to the Officer in Charge Botanic Station, Tobago.

Special quotations at St. Clair for Cacao, Coffee and Limes grown from selected seeds are as follows:—

Plants purchased in lots of 1 to 1,000 plants 3 cents per plant.	} Delivered at Nurseries uncrated.
Plants purchased in lots of several thousands 2½ cents per plant.	
Plants purchased in lots up to 100 at 4 cents per plant.	} Delivered at Railway Station, Port-of- Spain or Queen's Wharf, securely packed in open crates.
Plants purchased in lots up to 1,000 at \$8.50 per 100.	
Plants purchased in lots of several thousands at \$88.00 per 1,000.	

Tobago prices on application at the Botanic Station, Scarborough.

Budded Avocados select varieties at 12 cents, Budded Oranges at 24 cents and Grafted Mangos at 2½ cents should also be booked at once.

Budded Cacao 12 cents each or in lots of over 100 at 8 cents.

Limes from beds 1½ cents per plant for lots over 100.

A select stock is also kept of other fruit, ornamental and flowering trees, palms, etc., a list of which can be obtained on application. Large orders must be booked six months previous to the date when the plants are required as large supplies are not kept on hand for casual demands.

Board of Agriculture.

SPRAYING CACAO, &c.

From September to November is the time for spraying cacao trees for the prevention of thrips and black rot; and early in the dry season for the Aïgnal disease, die back, and cacao beetles.

The Board of Agriculture has on hand a supply of bluestone, which is sold to planters at 12 cents per pound, also nicotine sulphate the best insecticide for thrips, which is sold at \$14.50 per gallon.

Men will be provided to superintend any spraying work which estates may wish to have done.

Spraying Machines can also be hired in Trinidad or Tobago. Friend Pump, with two leads of hose and rods complete, \$1.00 per week.

Barrel Pump with one lead of hose and rods, 50c. per week. Carriage to and fro extra.

Further information in regard to cost of spraying, etc., and applications for bluestone and nicotine sulphate should be made to

PUBLICATIONS FOR SALE.

THE BULLETIN issued quarterly, price sixpence per number or two shillings per annum post free in the Colony. To other subscribers postage extra.

Vol. XVIII. 1919. Pt. 1.—Wither Tip of Limes (Illustrated); Yam Experiments 1918-19; Cultivation of Cotton; Nitrogen Content Cacao Soils; Supposed Cure for Froghoppers; Bedding Plants for Trinidad; Fungous Diseases of Roses (Illustrated); Prize Competitions 1918-19.

Vol. XVIII. Pt. 2.—Cane Farmers and Co-operation; Root Disease and Froghopper Blight; Control of Cacao Thrips; Rice Experiments, 1915-18; etc., etc.

Vol. XVIII. Pt. 3.—The Avocado in Trinidad and Tobago (Illustrated); Sugar-Cane Experiments 1917-19; Yams 1918-19.

OUR LOCAL FOODS: THEIR PRODUCTION AND USE, by W. G. Freeman, and R. O. Williams.—Price 3d.

THE DASHEEN: Its Uses and Culture.—Illustrated.—Price 3d.

THE AVOCADO IN TRINIDAD AND TOBAGO.—Illustrated.—Price 3d.

INSECTS AFFECTING VEGETABLES IN TRINIDAD AND TOBAGO, by F. W. Ulrich. Symptoms of pests, Treatment, Preparation of Insecticides, etc.—Illustrated.—Price 3d.

LIFE HISTORY AND CONTROL OF THE CACAO BEETLE, 3 coloured plates, by P. L. Guppy.—Price 6d.

INSECT NOTES FOR 1910-11. Miscellaneous Notes on Cacao Pests, by F. W. Ulrich.—Price 8d.

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THE MONGOOSE IN TRINIDAD AND METHODS OF DESTROYING IT, 2 plates, by F. W. Ulrich.—Price 3d.

CONTROL OF CACAO THRIPS. (Illustrated) by F. W. Ulrich.—Price 3d.

ANNUAL REPORTS, DEPARTMENT OF AGRICULTURE, 1916, 1917 & 1918.—Price 1s. 9d. each.

All publications can be obtained from the Head Office of the Department, St. Clair Experiment Station, post free within the Colony. The Bulletin is also on sale at Messrs. Muir, Marshall, and Davidson & Todd, Port-of-Spain.

BULLETIN
OF THE
DEPARTMENT OF AGRICULTURE
Trinidad and Tobago.

PART 4.]

1919.

[VOL. XVIII.]

Staff Changes.

The Secretary of State for the Colonies has appointed Mr. W. G. Freeman Director of Agriculture, as from May 1, 1917 the date of retirement of Professor P. Carmody. Mr. Freeman has been acting as Director since February 1, 1917.

Mr. J. B. Rorer, the Mycologist of the Board of Agriculture who was granted one year's leave from November 1918 to take up a temporary appointment with the Asociacion de Agricultores del Ecuador has resigned and is remaining in Ecuador.

Mr. R. O. Williams, Curator of the Royal Botanic Gardens and St. Clair Experiment Station has been appointed Agricultural Superintendent of Grenada.

Mr. L. H. Patterson who was appointed Clerk and Overseer at the Government Farm, Trinidad on July 1, 1919 retired from the Service owing to ill health on October 31, 1919.

Mr. Francis Chookolingo has been promoted to the post of Clerk, Botanical Department as from February 1, 1919.

Mr. Ali Hosein was confirmed in the post of 3rd Clerk at the Head Office on August 1, 1919. He has been acting since June 1916.

Mr. Ashraff Hosein has been appointed Clerical Assistant to the Superintendent of Field Experiments as from November 1, 1919.

Entomological Conference.

The Conference of the Entomologists of the Empire which had to be postponed from 1914 is to take place in June 1920 in London. Mr. F. W. Ulrich, Entomologist and Mr. C. B. Williams, Entomologist in charge of Frog hopper Investigations, will attend as representatives of the Colony.

Frog hopper Investigations.

Mr. W. Nowell, D.I.C., Mycologist on the Staff of the Imperial Department of Agriculture for the West Indies paid a second visit to Trinidad during October and November when he continued, in collaboration with Mr. C. B. Williams, M.A., the investigation of the part played by root disease in causing the condition generally known as blight. Mr. Nowell gave a short summary of the results obtained at the November meeting of the Board of Agriculture. A full report will be issued later in continuation of the former one (Bulletin—Department of Agriculture Vol. XVII. 1919).

Centenary of the Royal Botanic Gardens.

The Botanic Gardens of Trinidad has completed a century of uninterrupted work and is thus one of the very few tropical gardens of

the Empire which has had a continuous existence of one hundred years. To mark the Centenary it was hoped to publish this year, as a number of the *Bulletin*, a historical sketch of the Gardens and a descriptive account of the principal economic and ornamental plants of the Colony and their uses, etc. Pressure of other work, and a reduced staff, has prevented this being done, but the work is so well advanced that it will probably be possible to issue it as No. 1 or 2 of the *Bulletin* for 1920.

Appreciation of Cane Farmers' Competitions.

In a recent number of the *Louisiana Planter* a summary is given of the Report on the Cane Farmers Prize Competition in Trinidad, of 1918, and the value of the method as a means of Agricultural Education pointed out.

The suggestion is then made that similar competitions would serve a useful purpose in Louisiana. "It is a recognized fact that the hill lands of Louisiana and of Mississippi have made, and can again be made to produce, as high as 200 bushels of Indian corn per acre. As the common production is scarcely one-tenth of these prize figures we only cite them in order to show what can be done even under adverse conditions and the desirability of testing out these matters by prize competition and so we may all learn a lesson from our confreres in Trinidad and inaugurate prize competitions for sugar cane produced here in Louisiana."

Sugar Research Association.

"The *West India Committee Circular* of December 25, 1919, reports that at a Conference of Research Associations held during this month, Mr. A. J. Balfour, who presided, said, in his introductory address, that the industrial progress of mankind was going to be in the future more and more dependent upon the alliance of science and industry, and upon the co-operation of different branches of science with each other. It was only upon our increasing knowledge of the powers of nature that we could hope to improve the material lot of men. That knowledge could only be gained by the cultivation of pure science, of knowledge for its own sake, by contriving to educate men who, with no thought of self-advancement, were consumed by a curiosity to know, and, when, that stage had been passed, by learning how to apply the knowledge which they had disinterestedly acquired to the great purposes of industrial development.

"One of the Research Associations represented at the Conference is styled the British Empire Sugar Research Association, which has been formed to establish an Empire Scheme for the scientific investigation of the problems arising in the sugar industry. Another aim is to encourage and improve the technical education of persons who are, or may be, engaged in the industry. The Association is working in co-operation with the Imperial Government Department of Scientific and Industrial Research. The scope of the work includes the improvement of the sugar-cane, the various methods of extracting sugar, of refining it, and the best methods for the use of sugar as a raw material. Another point is the discovery of the best uses of the after-products of both factory and refinery. Sugar planters should heartily support this Association, as all research work on sugar will directly benefit them. The registered offices are at Evelyn House, 62, Oxford Street, London, W."

Trinidad Exhibit in Canada.

At the request of Dr. Marin the Board of Agriculture agreed to present a collection of the economic products of the Colony to the Laval University, Quebec. This was done and a letter of thanks have since been received from the Rector of the University. The following note is taken from the *Quebec Telegraph* of December 5, 1919:—

“An exhibit that should be of deep interest to Canadians who have been following the much discussed matter of trade relations between Canada and the British West Indies has been given to Laval University of Quebec by the Trinidad Government, and has been brought to the University by Mr. R. G. Marin, M.B., a student of that Institution, and a native of Trinidad.

“The exhibit consists of a unique display of the products of the island of Trinidad, which is situated in the extreme southern end of the West Indies archipelago, immediately off the northern coast of Venezuela, and one of the most precious of Britain's many small but important possessions. Mr. Marin has on display seven different grades of sugar obtained from Trinidad. There are also specimens of cane sugar, and bottles of white and coloured rum that are by-products of the sugar cane. The rum produced in Trinidad is of a delicious flavor, and possesses a ‘kick’ that is hardly to be equalled by many of the finest whiskies.

“In the exhibit there are specimens of cocoa beans, both in the raw and the cooked state. The exhibitor has a number of coconuts, which are excellent food when eaten fresh, and from the shells of which are made many other products such as fibre ware.

“Trinidad's position as a timber country is shown in the exhibit. Samples of various tropical woods are shown, such as different grades of mahogany, cypre and purple heart. The island is fast gaining reputation for furniture manufacturing.

“In brief, the exhibit given the University by the Trinidad Government demonstrates better than anything could do, the benefits that would be derived by trading more extensively with this part of the world, which, being a portion of the British Empire, would serve to keep trade within the Empire as much as possible to the benefit of all concerned in the commercial relations.”

W. G. FREEMAN.

PLANT DISEASES AND PESTS.

A ROOT DISEASE OF CACAO IN TRINIDAD.

ROSELLINIA PEPO.

By W. NOWELL, D.I.C. with an introductory note by
W. G. Freeman, B.Sc.

The death of Cacao trees from "root disease" has been known in the Colony for a long time, but does not appear to have been specially investigated. The cause of death has often been assigned vaguely to "canker at the root."

The root diseases of cacao and limes in some of the West Indian Islands have been the subject of research by Mr. W. Nowell, D.I.C., Mycologist on the Staff of the Imperial Department of Agriculture for the West Indies. His results are published in a paper "Rosellinia Root Diseases in the Lesser Antilles" *West Indian Bulletin* XVI. 1917 31-71 with twelve illustrations.

During Mr. Nowell's visit in 1918 to investigate the Froghopper blight of Sugar cane, he expressed to me his belief that although Rosellinia had not been recorded as a cause of root disease of cacao etc., in Trinidad and Tobago, it would be found here, considering its wide distribution in the West Indies and tropical America. Root disease of cacao is not very common in the Colony, and as Mr. Nowell had very little time available he had few opportunities for searching for it. A few trees were examined but without definite result.

During his second visit in 1919 Mr. Nowell and I visited an estate where trees in a particular area had died, special attention being directed to it by the hibiscus hedge dying out along the length of the same bed in which the deaths of cacao trees had occurred.

The section of the estate has recently been drained, and supplies planted to replace missing trees. The state of affairs found is represented in the following diagram:—

Hibiscus Hedge.—Dead.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
DRAIN.	S.....	.....	t.
	t..	.....	T.
	t.....	.....	t.
	D.....	.....	S.
	t.....	.....	t.
	t.....	.....	t.
	S.....	.....	t.
	D.....	.....	—
	T.....	.....	T.
	.....	.....	T.
	T. Apparently healthy trees ...	...	4
	S. Sickly trees ...	...	3
	D. Dead trees ...	...	2
	— Missing tree ...	...	1
	t. Young supplies...	...	9
			19
		Total...	19

Mr. Nowell examined the trees etc., and diagnosed the cause of disease as *Rosellinia Peco* which is described in detail later.

The roots of the dead and dying hibiscus showed the smoky green mycelium of the fungus (Fig 4.) The roots of the recently killed cacao trees had the characteristic fans of white mycelium between the bark and the wood. (Fig. 3.) Fruiting stages were found on the cacao and also on the stump of an Immortel in the next bed which had also died.

The following account of *Rosellinia* with special reference to its attacks on cacao, is taken from the paper by Mr. Nowell referred to above. The blocks of the illustrations have been kindly lent by Sir Francis Watts, K.C.M.G., D.Sc., etc., Imperial Commissioner of Agriculture in the West Indies.

It should be noted that the disease is presumably not an introduced one. The fungus which causes it is native to tropical America and the West Indies, occurring in the forests, and is distributed by pieces of dead wood with the fungus on them being washed down to low lying areas on cacao estates. The disease can be got rid of by careful attention to the measures recommended by Mr. Nowell (p. 189). The position is therefore that planters have not a new disease to contend with, but now know the cause of a disease of old standing and know also how to eradicate it.

The disease is however a serious one and neglected may lead to severe losses.

W. G. F.

ROSELLINIA PEPO., PAT.

This species was originally described by Patouillard in 1908 from material on the bark of *Hymenaea Courbaril* collected by Duss in Guadeloupe. In the British Antilles the perithecia have been collected in Dominica, St. Lucia, and Grenada. From the published accounts of root diseases in Jamaica, Porto Rico and Martinique it seems probable that the species also occurs in those islands.

Its most general importance is due to its attacks on cacao, but it is capable of producing destructive effects on any of the ordinary crop plants, herbaceous or woody, which are planted on land recently cleared from forest. Under such circumstances, limes in Dominica have suffered severely from this species, as well as from *R. bunodes*.

Where cacao trees have been killed by the fungus and other plants have been put in for temporary fillers, I have seen dasheens, bananas, pigeon pea, cassava, and horse bean all attacked. Sugar cane has several times been seen to survive, but I cannot say that it is really immune. Barber includes it in his list of plants affected.

Patouillard's description of the fungus is as follows (trans.):—

Perithecia scattered or in groups, situated on the crustaceous conidia-bearing subicle, globose, somewhat stalked, 2.5 to 3 millimetres in diameter, dark brown carbonaceous, furnished with a conical shiny black osteole, remaining closed, surrounded by a darker somewhat more flattened areole; asci elongate, capitate at the apex, furnished with an ovoid pore, turning blue with iodine, much attenuated below, eight-spored, 10 to 12 microns in breadth; paraphyses numerous linear; spores brown, straight, fusiform, pointed at each end, measuring 62 to 67 by 8 to 9 microns, at first increased at each end by a glassy halo, later bare.

There are present erect conidiophores (Graphium) 1 to 3 mm. in length, 30 to 60 microns broad composed of brown septate hyphae 4 to 6 microns thick, situated on the crustaceous subicle. Conidia not seen.

The perithecia are borne, usually at the base of the stem, amongst and in succession to the conidial fructifications, on the somewhat carbonaceous layer which is formed on and in bark which has become thoroughly infested.

The perithecia are formed much less freely than in the case of *R. bunodes*, and in spite of long-continued search, material containing ripe asci has only once been obtained in the British islands: this was found by the writer on a dead lime tree in Dominica, in a situation with an annual rainfall of some 250 inches. Examination of this material at Kew enabled Miss E. M. Wakefield to identify the fungus as Patouillard's species.

The perithecia are normally slightly verrucose (Fig. 1) but are sometimes found smooth. Apparently this is due to weathering, though possibly (cp. *R. bunodes*) there is some variation in the amount of roughness developed.

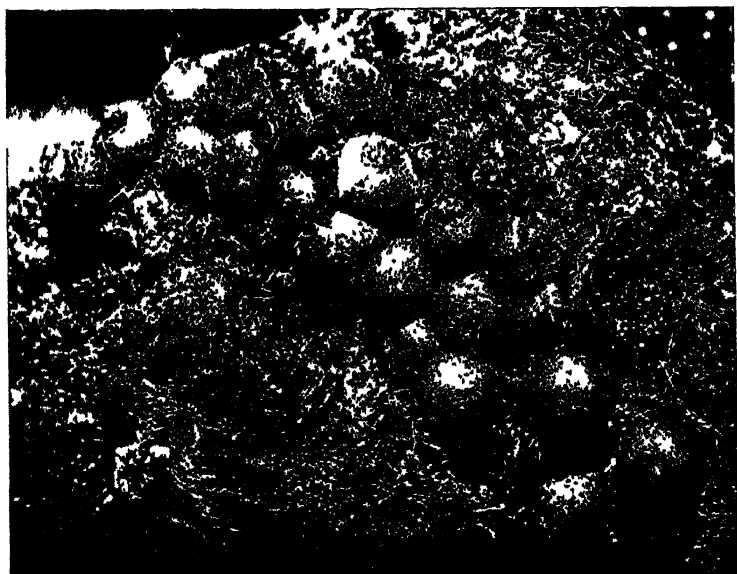
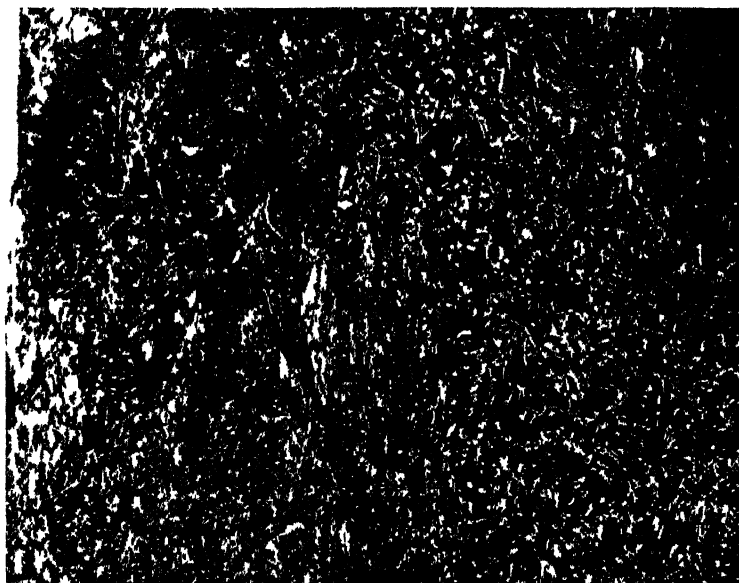


Fig 1
ROSELLINIA PERITHECIA. $\times 31$.



The conidial fructifications are of the *Graphium* type figured by various authors in connection with *Rosellinia necatrix* and other described species. They occur previous to the development of perithecia and are borne on the black surface mycelium which develops wherever the fungus reaches the open under damp conditions. Each has the form of a black bristle-like stalk 2 to 3 mm. long, built up of perpendicular hyphae which branch out freely at the top into a tuft, which is white or whitish to the naked eye from the conidia which cover it. The conidia are borne laterally towards the terminations of these branches; the cells which bear them have a somewhat zig-zag or corkscrew appearance from their tendency to bend away from the point of attachment of a conidium. The conidia are rounded or oval, one-celled, about 5 microns in length.

The conidial fructifications are developed in very great abundance (Fig. 2) and have been seen on dead leaves, twigs, and old lime skins lying under close shelter beneath infested trees.

The most striking characteristic of this species is the production of fans or stars of white mycelium in the region of the cambium (between bark and wood) of the roots (Fig. 3). The presence of these distinguishes it at once from *R. bunodes*. A somewhat similar appearance may be produced by the unidentified species (C), but in the examples of the latter fungus seen, the growth has been very much less vigorous,

On the roots the mycelium forms an irregular coating over the surface. In its early stages it is smoky grey in colour, but soon becomes black. It is gathered at first into rather loose branching strands with spreading hyphae between them. Later the whole is combined into a layer which is more or less woolly on the surface, and tending to be carbonaceous below. It forms dense layers and pockets in the outer bark, and from these whitish strands more or less vertical to the surface everywhere penetrate the cortex. On reaching the surface of the wood these repeatedly branch and spread in all directions over it, so that when 'bark' and wood are separated, a conspicuous white pattern of branching lines, stars and fans is seen on the surface of the wood and repeated on the inner surface of the 'bark.' From this layer strands penetrate the wood in radial lines along the medullary rays, and send out hyphae which invade and fill the large vascular elements. In this species the mycelium in the wood, owing to its lack of colour, is not apparent to the naked eye unless a cut surface is exposed for a day or two, when the hyphae grow out and turn black. In long-infested wood, thin plates, seen as black lines in a section, mark off certain areas, and are believed to belong to this fungus. Such plates, however, are very common in dead wood, and so have little diagnostic value.

The external mycelium is most fully developed and conspicuous when the fungus reaches the base of the stem and appears above the surface of the soil. It is then seen in broad spreading fans or an advancing sheet, which from the beginning or at an early stage encircles the stem (Fig. 4). The margin while actively advancing is light grey in colour for a width of about half an inch, behind which the colour shades off to brown or black with a greenish tint. On lime bark the sheet is smooth and glossy rather like wet fur.

The height to which the fungus reaches is determined by the moisture conditions. When the stem is well exposed it reaches no further than the few inches for which the moisture of the soil can affect it; if the stem is enclosed by weeds, or low branches, or sheltered by a log, it commonly goes up for a foot or more. In a case seen of a bread-fruit tree growing against a bank 4 feet high, it extended upwards for that distance. The limit of the external mycelium is also the limit of the ultimate infestation of bark and wood. If a diseased tree is up-rooted, or is cut below the limit of infestation, and thrown aside where weeds grow up and shelter it, the fungus extends to the whole of the stem and branches thus kept moist.

In the rootstocks of herbaceous plants, as in thick soft bark the firm round strands of mycelium, buff-coloured without, white within, penetrate the parenchyma in all directions.

MODE OF CONCURRENCE OF ROSELLINIA DISEASES.

As seen in the West Indies, the diseases due to *Rosellinia*, with the exception of that on arrowroot, occur; (a) on land recently cleared from forest, still containing the dead and dying stumps of the forest trees and retaining a considerable amount of the forest humus; (b) in cacao cultivations the conditions in which, especially where shade trees are abundant, approach more or less closely to those of forest in respect of shade and humidity; and (c) in wind-breaks and hedges of certain susceptible trees in wet districts. The prevalence of the diseases is very distinctly governed by humidity. The types due to *Rosellinia Pepo* and *Rosellinia bunodes*, which alone have any considerable economic importance, are most virulent in the wet uplands of Dominica, St. Lucia and Grenada; the former follows the cacao cultivations down the more sheltered valleys to the coastal districts; the latter has not been met with away from the hills.

THE CENTRES OF THE DISEASE.

α. IN NEW CLEARINGS.

The fungi concerned have not been found in a purely natural habitat, *i.e.*, in undisturbed forest, although sought for to some extent. From the mode of their appearance in recent clearings there can however be little doubt of their existence there as a part of the natural flora.

It is the usual custom in these islands, when clearings are made, to burn as much as possible of the smaller material, but to leave the logs on the ground to rot, and to make no attempt to remove the stumps. Many of the latter send up suckers which have to be cut away from time to time. Under these circumstances it takes very many years before the logs and stumps finally disappear, and during the course of their decay they make the soil around them dangerously rich in crumbling woody matter and humus.

On land so prepared as soon as the felling and burning are finished, nursery plants are set out in the spaces between the stumps and logs. To get anything like regularity of stand many have to be placed close up to these obstacles.



Fig 3
ROSELLINIA WHITE MYCELIUM UNDER BARK Nat size



Fungi are of course very abundant on the decaying material, but the *Rosellinias* are far from being conspicuous among them. I have once found in Dominica a large decayed log infested with the mycelium of *Rosellinia bunodes*, as shown by the infection at the point of contact of lime branches touching it, and infection of a shrub growing upon it, and have found three other species on *Erythrina* logs in a St. Lucia cacao cultivation.

Nor have the *Rosellinias* been found so often as might have been expected on forest stumps. In a fruiting condition they are in fact rare in this situation. The most notable case I have seen was that of a chataignier stump (*Sloanea* sp.) covered with perithecial and conidial fructifications of *R. Pepo*, which from its position appeared to be the centre of infection of a large group of diseased limes. The presence of the mycelium on the buried roots of forest stumps is more frequently observed. Every infested clearing shows examples of the association of diseased trees with stumps, and sometimes these are very striking, as when a group of five or six dead and dying trees is seen around a large chataignier. The actual nature of the connexion is usually difficult to demonstrate; as a rule the cases when seen are too far advanced for sure conclusions, and often they have to be passed over for want of time or means for the uncovering of the roots. But from first to last a good many cases have been investigated in which the roots of diseased trees have been found in contact with roots of forest stumps bearing the fungus. In some of these the evidence that the fungus passed from the stump to the lime tree is quite definite. Two examples in which the evidence includes the identity of the forest tree may be cited. South (1918) reports having followed up the fungus from dead mahoe cochon (*Sterculia caribaea*) to the roots of a living lime tree; the writer examined a large stump, still bearing a few living suckers, of chataignier grand-feuille (*Sloanea Massoni*) the roots of which were badly infested and had recently communicated the fungus to the roots of a lime tree in contact with them. In other cases a single root coming from the direction of a stump has been found to be infested when all others were sound. From the nature of the case, examples in an early stage are only found by accident or a lucky shot, so that one is justified in assuming that a fair proportion at least of infections near stumps take place in this way.

The fact remains that considering the area of the clearings, the number of infested stumps does not appear to be large. Relatively few trees are lost in the first three or four years after planting. This is in part due to the time taken (a) by the fungus to develop on and about the stumps, (b) by the roots of the planted trees to grow out into the infested area, and (c) by the fungus to kill a tree after infection. But observation shows that when the period of heavy losses ensues, most of the trees are infected from one another, so that the characteristic distribution of the disease is in scattered patches whose number is very small compared with that of the stumps and logs in the clearing.

There is strong reason to believe, and the idea is supported by experience in other countries, that the number of forest trees whose stumps readily serve as centres of distribution for the fungus is quite

limited, and that the presence of the stumps of these especially susceptible trees in clearings has a good deal to do with the appearance of the disease. It is a well-known fact, already referred to above, that there is such a special susceptibility in the case of certain cultivated and semi-cultivated trees. Accurate information as to the identity of the forest trees most concerned is difficult to obtain. By no means all the forest trees have been identified, and to such as have, the patois names which form the connecting link with local knowledge are often loosely applied. In Dominica a large number of cases certainly occur in connection with deeply buttressed stumps commonly referred to *chataignier*, a name usually identified with two or three species of *Sloanea*. One planter has suggested that the closely similar stumps of *bois cote* are in his district more commonly the source of the trouble. Infection from the roots of *mahoe cochon* (*Sterculia caribaea*) and *chataignier grand-feuille* (*Sloanea Massoni*) in Dominica has been already mentioned. South and Brooks give *mahoe piment* (*Daphnopsis tinifolia*) and *bois cabrit* or *goatwood* (*Algiphila martinicensis*) as susceptible trees in St. Lucia. The perithecia of *R. Pepo* were described by Patouillard from locust (*Hymenasa Courbaril*) in Guadeloupe.

The disease is unknown in the older lime estates, which have no recent clearings. This cannot be regarded as wholly due to the much lower rainfall which most of them receive, since even near the coast lime trees contract the disease when planted as substitutes for diseased cacao. There is moreover at least one forest estate in the same district as some which are badly affected, where the clearings are old enough for the stumps to have disappeared, and where, in the limes which have replaced the crops first planted, root disease has given no trouble. In comparing this position with that of cacao cultivations, in which the disease due to *R. Pepo* is very liable to appear after they have been long established, it has to be remembered that the canopy is not so dense in a lime field, and that shade trees are not grown.

b. IN CACAO CULTIVATIONS.

In the great majority of cases the disease occurring in cacao has its origin in the trees grown for shade. When these are cut out, as often becomes necessary as they get too large, the stumps are left to rot and a condition is produced comparable in essentials with that in the clearings just discussed. The danger is well known to planters, especially with regard to breadfruit and avocado pear trees. A Grenada planter of long experience claimed that on several occasions when root disease had appeared in his cacao he had been able to trace it to the decay of breadfruit roots cut through in digging drains. I have seen the fungus on stumps of cacao trees which were healthy when cut down in thinning operations.

Apart from this, trees of the kinds named are rather liable to die of their own accord. How often this is due to their contracting Rosellinia disease, and how often they become infested with that fungus only after the death of some or all the roots from other causes, I can form no opinion. When, as often happens, the stumps are those of healthy trees, cut down for other reasons, obviously the latter is the



Fig. 5.

ROSELLINIA: EARLY STAGE OF INFECTION ON CACAO
ROOT. Nat. size

case. The observed facts as they regularly present themselves are these: that one or more of the cacao trees immediately adjacent to a sickly or a dead shade tree, or shade tree stump, begin to show symptoms of root disease, and removal of the soil reveals the fungus advancing along one or more of the cacao roots from the neighbourhood of roots of the shade tree, which are found to be infested, and usually in an advanced stage of infestation. Sometimes actual contact has been proved, sometimes not. In view of the difficulties of digging among roots the negative evidence has not much weight. The trees most often concerned in connexion with the the disease on cacao are avocado, breadfruit, and pois doux (*Inga* spp.). Immortel (*Erythrina* sp.) and mango are sometimes but not often involved.

The fact should be mentioned here, though its discussion belongs rather to the next section, that the disease can occur on cacao trees in the absence of stumps or any obvious dead wood. Cases of this nature are as a rule uncommon, but in only one badly infested area examined a fair number were seen.

METHODS OF INFECTION.

Several of the authors cited in the first part of this paper refer to the spread of the fungus through the upper layers of the soil and in accumulations of decaying vegetable matter on its surface, resulting in the infection of trees at those levels. The usual mode of occurrence of the disease in the West Indian cacao plantations does not bring out this feature at all clearly. With the exceptions alluded to above, the disease is generally clearly traceable to dead roots, which are often deep underground, and its course is along one or more of the cacao roots in the direction of the stem. All stages of the process have been seen, and quite commonly in the less advanced cases the crown is found still unattacked.

The cases sometimes met with of cacao trees becoming diseased in the absence of stumps can be accounted for by infection of the surface type. A living root was found which had been injured where it came to the surface, and from two points on the margin of the injuries white fans recognizable as the mycelium of *R. Pepo* were found radiating under the bark. This example is illustrated in Fig. 5. The cases noted have been in the wettest districts, where production of organic matter is at a maximum, and where cloudy days, the depth of shade produced by luxuriant growth, and the saturation of the soil with water, all reduce the rate of its destruction. Where rainfall and shade are not excessive, the addition of organic matter to the soil does not keep pace with its decay, and the general run of soil on the ordinary cacao estate is not particularly rich in humus, nor is there much, if anything, in the way of leaf mould on its surface.

The spread of the disease along closely planted hedges and wind-breaks, of which some striking instances have occurred in St. Lucia, is characterized and probably mainly effected by infestation of the surface soil. The leaves and twigs which accumulate along the base of the wind-break, and decaying, enrich the soil with humus, and the shelter afforded by the trees and by the vegetation which grows up under their

protection provide conditions especially suitable for the fungus. It creeps along the line like a smouldering fire, killing off the trees and their seedlings, and most of the shrubby and herbaceous vegetation, as it comes to them. In a gap so produced, from which the stumps had been removed, a line of living fence posts subsequently put in consisting mostly of white cedar (*Tecoma leucoxydon*) were three months later infested to soil level. Wind-breaks of pois doux and galba (*Calophyllum Calaba*) are very susceptible to the disease.

The evidence thus shows clearly that the spread of the fungus may take place in two ways: (a) underground along the roots of diseased trees or infested stumps, in which case one or more outlying roots of the new contacts are usually first infected and the fungus travels along them to the collar, infecting other roots as it crosses them; (b) by the growth of the fungus through rich and damp (which usually means shaded) surface mould and vegetable debris, in which case the fungus first attacks surface roots or directly infects the collar.

How the infection originates is not known. Tradition, the whole course of planting experience, and many definite observations by agricultural officers, combine in associating the first outbreaks which occur with the presence of stumps in new clearings, and of dead or sickly shade trees in older plantations. The theory as to the general course of infection which seems to the writer to best fit the facts at present known is this: (1) that the fungus is able, by means of its spores (of which the conidia are by far the more abundant and the more likely to be distributed by the wind) to infect any accumulation of decaying vegetable matter in damp soil; (2) that the required conditions are most often presented in the immediate neighbourhood of mouldering logs and stumps; (3) that a surface infestation thus begun may or may not communicate the disease directly to the cultivated trees: in the earlier stages of a plantation the chances are considerable that it will not, owing to (a) disturbance of the humus-bearing surface soil in planting the trees, and (b) the lack of shade conducing to rapid destruction of organic matter in the soil around; (4) that infestations round about the stumps of certain trees, on the other hand, are communicated to the roots at and about soil level, the fungus finding in the buried roots a food supply situated in permanently congenial conditions, so that it is able to follow them out to their extremities however far and deeply they may run, thus establishing a long-enduring and wide-spreading source of infection for the roots of cultivated trees which extend into contact with them.

As the trees grow large and produce a deeper shade, so protecting and keeping moist the organic matter which accumulates beneath them, the conditions for surface infection are greatly improved, and by this time, owing to the production of spores on the remains of the trees previously killed, the chances of any suitable patch of soil becoming infected are much greater. At this stage, therefore, the proportion of cases originating by direct infection from the soil will have risen, and such cases may in time far outnumber those associated with stumps.

Another type of situation continuously capable for a long number of years of becoming infested is presented by the soil on the shaded underside of logs, the disintegration of which, especially that due to the tunnelling of insects, maintains a plentiful supply of organic matter.

Once the disease has got a footing however, the greatest amount of loss is caused by the spread of the fungus along the roots (as it commonly appears) or over the surface (where conditions of shade permit) from one cultivated tree to others about it in an ever widening circle. In one case the loss of about 150 trees appeared to be clearly traceable to two original centres of infection.

Wherever a tree has died, unless strict measures have been taken to control the fungus, the adjacent trees almost inevitably contract the disease sooner or later. Such cases may arise years after the original tree has been removed and the cause of its death forgotten, so that they have the appearance of being sporadic. Examination of the position and age of supplies, and the keeping of records of surveyed areas enable them to be linked up with considerable certainty to previous losses. How far such belated cases are evidence of the slow progress of the fungus along the roots, or how far they are due to delayed infection has not been ascertained, but the general evidence points to the conclusion that the process of investment of mature trees is a distinctly slow one. In a case definitely recorded, a fully infested dead lime tree was removed in October 1914, and the fungus (*R. bunodes*) was just coming up round the collar of the next tree in the row, a very large and vigorous specimen, in August 1916. The variety of circumstances must produce wide differences, but I should judge that the two years taken in this case is not an unusual period, and is in some cases considerably exceeded.

Typically an infested clearing in which the disease is of several years' standing shows a few large open patches, each representing perhaps a score of trees, with usually two or three around its margin dead or dying, and several more on which the fungus may be found. Sometimes two or three such patches have coalesced. Scattered about are fresh centres in various stages: a single tree, a gap of two or three trees in a row, with another going, or a group of two or three in different stages about a large stump. Of the supplies put in, some are several years old and still thriving, others are dead within a few months of being planted.

APPEARANCE OF DISEASED TREES.

As the disease is seen on lime and cacao trees there are two types of failure of the top. In the one, where the roots become more or less generally infested before the fungus gets fully hold of the collar, as commonly happens where its approach along the roots is checked by drier conditions around the crown, defoliation is gradual and is preceded by yellowing of the leaves and a general sickly appearance of the tree. In cacao especially, this is the common form of failure and resembles a severe type of die-back, such as is brought about by poverty of soil or exposure. The development of vigorous suckers excludes *R. Pepo* as the cause of such a condition but their non-development on failing trees does not necessarily indicate its presence.

The second type of failure common on lime trees in the districts indicated, and occurring sometimes on cacao, is produced when the stem is girdled by the fungus while most of the root system remains yet uninfected. In lime trees the earliest outward sign of the disease in such cases, so far as I have seen, is the production of an abnormally large crop of fruit. Presumably the production of flowers would be equally striking, but this I cannot say from observation. Before this crop of fruit has had time to ripen the foliage drops, often with such suddenness that the ground is carpeted with leaves still green. The appearance which the tree then presents is a familiar one in the affected districts: its branches nearly bare of leaves and hung with shrivelling and prematurely yellow limes. In an observed instance a tree of perfectly healthy appearance, with abundant dark foliage, was found on October 20 to have its bark all round and for some distance up the stem infected through and through with *Rosellinia*; it remained green until November 17, and then the change from healthy foliage to naked twigs was completed in from twenty-four to thirty-six hours.

When relieved from loss of water by the fall of the leaves a tree may put out a few small shoots and linger for some time before it completely dies. It often happens that as the bark near the soil level is killed, tufts of adventitious roots are pushed out from a callus formed at the edge of the sound bark above. Quite a dense mat of small roots is formed, some of which may get a good hold of the soil and thicken up. This sometimes enables the tree to struggle on a little longer, and even raises hopes of its recovery. Such an event is very improbable, as the new roots soon become infected after they reach damp soil.

INCIDENCE OF THE DISEASE.

The disease as seen on the Dominica lime estates is by no means regular in its incidence. It is a matter of general and rueful experience that it develops its attacks most widely in the best clearings, and that the finest trees, which is to say those growing in the deepest and richest soil, are the most liable to be infected. In clearings on thin soil and on the considerable area of upland flats where the soil is underlain by a stony 'pan' which prevents anything like adequate drainage, diseased trees are rare, and do not as a rule lead to further extensions unless they happen to be situated in a deeper pocket in the one case, or on a drier slope in the other.

These experiences are exactly paralleled in Porto Rico, where 'the disease often does most harm amongst the best trees, the sun-exposed slopes of poor coffee plantations remaining quite free from trouble.' 'The only things which retard or stop its progress seem to be excessively dry or excessively wet soils, natural barriers, such as brooks, and the scarcity of food material (decaying vegetation) in the soil.' (Fawcett 1916.)

This is not to say that slow-growing stunted trees are at all resistant to the fungus. Where the roots of such trees happen to come in contact with infected material they are killed as readily as any others.

The explanation of this feature of the disease is to be found in the favourable conditions of shade, moisture, and abundance of organic matter, produced by the heavy canopy of well-grown trees. It is in such situations that soil infections, without the intervention of stumps,

are very liable to occur. The comparative rarity of cases in the clearings on thin soils is in keeping with the theory put forward that the original sources of infection in any clearing are few in number. In poor clearings the cases mostly remain restricted to these. Something may be due however to the difference in the constitution of the original forest.

In cacao plantations the conditions are usually more uniform, and differences in the distribution of the disease are not well marked. There is however a noticeable tendency for outbreaks to occur along the course of ravines and on small enclosed alluvial flats. Among cacao, in the situations so far studied, infection apart, from contact with stumps or diseased trees, seems, as already remarked, to be relatively rare.

COUNTER MEASURES.

PREVENTION.

IN NEW LIME CLEARINGS. It would be a counsel of perfection to recommend the removal of stumps or even of logs from new clearings in their earliest stages. In West Indian plantations such a policy is not economically possible. But in arranging and planting new clearing for orchard crops, the probability that root disease will occur should be kept in mind, and certain precautions can be taken which will considerably reduce the trouble to be faced when disease appears.

First among these is provision for the construction, immediate or when occasion and funds permit, of a complete and close system of trench drains. To this end the arrangement of the trees should be planned so that each block shall be isolated from the rest by main drains and, where possible, each row separated from the next by a trench. There will be many patches encumbered with logs and stumps over which for some years the system will extend only in the plan, but it is necessary to take long views, and too many cases have been seen where, when the need for a trench has urgently arisen, the line has been brought up against trees irregularly planted and now too valuable to be destroyed. Drains are being considered here, of course, not in view of their primary function of removing water, but as isolation trenches preventing the spread of root disease from tree to tree. At the same time thorough drainage may be considered to have direct value from the point of view of Rosellinia disease, for although, as has been pointed out, the fungus does not thrive in water-logged soil, neither do the trees and when that condition has been passed, the drier the soil can become the quicker is the decay of organic matter and the less favourable the conditions afforded to the fungus.

It has been not uncommon in both lime and cacao fields when a large stump has appeared to be a centre of disease, for a trench to be dug around it cutting off the widely extending roots. When the fungus has already got into the root system this measure usually comes too late, but if it is applied to large stumps at the outset, especially to those of susceptible species, it may be expected to have some success. Possibly a variation recently suggested by A. Sharples (1915), namely, the following out of each main root separately and removal of a section where it gets down to about 2 feet from the surface, may have the advantage over a trench that the cut ends are not left open to infection.

On the other hand, without trenching all round it cannot be assured that all the roots are cut, and the smallest is capable of conducting the fungus outward or inward, as the case may be. The best plan would probably be to dig a trench some 2 feet wide well away from the stump, remove all sections of roots, and fill it in again.

In planting the trees, positions in close proximity to stumps should as far as possible be avoided, and a good deal may be done in the way of re-arranging the smaller logs so that they do not form too close a shelter about the stem of the prospective tree. Beyond these measures little, for the time being, can be done. If the theory that the sour orange stock is more resistant than the lime is shown by the experiments now in progress to be well founded, then it will be advisable to plant such situations as experience has shown to favour particularly root disease with limes budded on that stock.

When the first few years have passed and the logs are more or less rotted, it has been shown to be quite feasible to hasten very materially the time of their disappearance by cutting or breaking them up so that they can be easily handled. Merely to dispose of them better by dragging them away from the stems of the trees is a considerable gain, and in some cases it has been found possible to stack much of the material, and even to make good use of it for fuel. The great convenience, quite apart from root disease, of having the ground clear, should be an additional inducement to the planter to make every possible effort to this end.

A point to be always kept in mind is that wood which can dry out from time to time, *e.g.* logs, stumps, or parts of them which are raised above the soil and not shut in by weeds or overhanging branches, is in little danger of harbouring the fungus.

The same consideration applies to the soil. In damp and sheltered clearings such as are favoured by the fungus, all that is possible should be done to encourage the free circulation of air beneath the trees. Low hanging branches which maintain a closely sheltered circle around the base of the tree induce conditions which invite surface infection, and should most certainly be cut away. Grass and weeds should be kept short all the time, not merely in the crop season.

It is highly desirable in infested clearings and especially in the neighbourhood of infected spots, to go further and clear away the soil and weeds about the base of the stems, completely baring the collars, and liberally exposing the main roots so far as this may be done without forming a saucer in which water will stand. The treatment of the collar and the recesses between the roots with lime-sulphur solution to keep the bark free from moss gives an added protection of considerable value.

All these measures are summarized in the word ventilation, and cannot be too strongly emphasized. The fungus cannot tolerate dry conditions and it is for the planter to take every advantage he can of this weakness.

IN CACAO PLANTATIONS. There are probably few managers of cacao plantations who would nowadays plant breadfruit or avocado trees through their fields. The idea of the more economically minded of the old planters seems to have been that since shade trees were to be grown, they might as well be such as would give something in the way of food in return for the room they occupied. The modern idea of the manurial function of shade trees leads to a preference for leguminous trees, and justifies the more orthodox tradition which led to the planting of immortelles. Where avocado and breadfruit trees are already established, the planter who has learnt respect for the root disease has two courses open to him. The one is to take the utmost care of such trees, to prune out dead branches, to avoid injuries to the roots and generally to try to preserve them in health as long as possible; the other is to take them out as occasion offers, removing the stumps, and following out and removing every root that can be got at. This is usually difficult because of the adjoining cacao trees; where the trees to be dealt with are large, it becomes formidable. The easy course is to cut down or ring the trees, and leave the roots to rot, but that way trouble lies. It does not always happen, but striking, one might say startling, cases have been seen where the cutting down of an avocado or breadfruit in the cacao, or a *pois-doux* by the roadside has led to the appearance of the disease in places from which it has thought to be far removed. These three trees are the chief victims, but there is none that can be considered to be really safe. It should be the settled policy of cacao planters in wet districts to leave no woody material to rot in the soil if it can possibly be avoided. Where there is deep shade and high humidity, any vegetable matter used as mulch may be a source of danger, though one that may have to be risked in view of manurial requirements. The more careful and prompt the attention that is given to any appearance of the disease on the plantation the less will the risks of this nature be.

With regard to wind-breaks; where experience has shown that there is danger of disease arising, it is advisable to keep them as free as possible from undergrowth, and to scrape away any accumulations of leaves or other material from hollows or other sheltered places. This might be used as mulch in dry places or preferably, if there is a pen near, for the making of pen manure.

TREATMENT.

In a recent pamphlet (1915) the writer has stated that attempts to cure infected trees may be put aside as in most cases hopeless and in the remainder doubtful, and as involving so much skilful surgery as to make them impracticable on any but the smallest scale. Addressed to the planter as he has usually been found, concerned with matters of primary urgency and with very inadequate assistance, the words may still stand. As regards trees with deep-seated or well-established infections there is indeed no more to be said. But actual experience, as illustrated in the cases previously detailed, has shown that in fields in which the disease is established and surface infection is taking place, an examination of the trees, involving no more than an initial clearing and periodic inspection of the crown and collar, will directly save many

lightly infected trees, and indirectly by preventing the formation of new centres of distribution, save very many more. All that is needed is to have the lower branches pruned sufficiently for access to the trunk, a couple of labourers to go on ahead and clear away weeds and earth for a foot or so around the junction of roots and stem, preferably using their hands or a blunt instrument to avoid wounding the bark, and then to make a few minutes' investigation of each tree so prepared. In addition to saving trees, such a system enables the hopeless cases to be detected long before they otherwise would be, and makes it possible to deal promptly with them. One is justified here in being insistent and saying that in every clearing in which the disease has become established, such an inspection ought to be made at least twice a year. It is after all a mild proposal.

The principles of the actual treatment required are two in number, and very simple: (a) complete excision of diseased tissues; (b) exposure as complete as possible of the affected part and its surroundings to freely circulating air, with the object of making the conditions too dry for the fungus to exist. In operating it must be remembered that after the early stages the fungus penetrates wood as well as bark. It is the drastic surgery made necessary by this fact, and the propensity of the fungus for lateral spread in the outer zone of roots, that make the saving of cases at all advanced so hopeless. Commonly in such a case a great part of the root system has to be cut away, and the roots severed in the operation and left behind give every opportunity for the disease to re-assert itself.

The cases which repay treatment are those arising from surface infection, in which on inspection the local nature of the infestation appears to be clearly defined. Severed roots should as far as possible be removed; cut surfaces should be cleanly trimmed and dressed with paint; excavations made to get at the seat of injury should be left open. It should be hardly necessary to say that the material removed must be carefully disposed of. These directions may give rise to an exaggerated idea of the elaborateness of the treatment required but in many cases a few cuts with a sharp knife will save a tree from an infection which would have meant its certain death.

Where the disease has been detected advancing along one or more large roots but has not reached the collar, and it is desired to give the tree a chance of recovery, then after the diseased roots have been cut away, as much soil as possible should be dug out about the junction of the main roots and as far back as they can be conveniently followed, leaving the tree more or less on stilts as it were. This prevents the crossing over of the fungus at or near the collar, and may very considerably delay the loss of the tree, but if the fungus, as is probable, exists on the outer roots, it will in time get round in that region and come up each of the main roots in turn as far as the point to which it has been bared. It is not a measure to be recommended. It is better to have the tree out and be rid of the fungus, but the temptation to get an additional crop or two from some specially fine tree is sometimes hardly to be resisted.

The directions here given as to treatment apply equally to limes and to cacao, but as has been previously indicated, with the latter crop, so far as the writer's experience goes, the cases are more usually of the deep-seated kind, which does not permit of successful treatment.

CONTROL.

REMOVAL OF DISEASED TREES. When an infected tree is found it is well that its destruction should be prompt, but it is an advantage to choose a dry day for the operation. If the disease is so far advanced that the fungus is producing conidia, either on the stem or on dead leaves and twigs lying about, then before it is distributed the spore-bearing surface should be flamed with a torch or by burning trash of some description around them (Petch 1910). This disposes for the time being of the means of aerial dispersal of the fungus, and removes what is otherwise a real danger of the carriage of infection on the persons and implements of the labourers.

The diseased tree should be cut down, the stump dug out, and the roots followed up and removed as completely as possible. One planter gets out the fragments with a builders' sieve, and has had unusual success with his supply plants. It is convenient for the labourers to have baskets handy into which the small roots can be thrown as they are dug out, otherwise they are in danger of being scattered.

The diseased material should be destroyed by fire, preferably on the spot. It has been formerly stated that the whole tree should be cut up and burned, but I have recently satisfied myself that the necessity for this, which has often been a real difficulty to planters trying to follow instructions, may be avoided. It is easy to see how far the fungus has reached, and if the stem be cut above this point, and the top be disposed of in such a way that it can dry out, it will not develop *Rosellinia*. This has been verified on trees thrown into the edge of the forest, provided they did not rest upon the ground, and on others perched on large stumps and on rocks. It is better to dispose of even the stump in some way than simply to leave it lying about as is too frequently done, but all material actually infected certainly ought to be burned. No material, root or stem, infected or uninfected, should be left lying on the ground. In one instance the stem of a cacao tree, some 5 feet long, which had been charred and thrown aside in the grass was found sheathed from end to end with conidial fructifications, and stems and branches of dead lime trees have been frequently seen, where they have rested for some distance on or close to the ground, in a similar condition. Had they been wedged among the branches of a tree they would have been quite harmless.

Under some conditions it may be necessary to choose a convenient situation and carry to it the material to be burned, but such transportation has obvious dangers in the way of scattering bits of diseased material. It should certainly be preceded by the scorching of any spore-bearing surfaces. A kerosene blow-lamp is a useful appliance in connexion with the scorching, and in starting fires.

TREATMENT OF THE SOIL.—Attempts have naturally been made to arrest the progress of the disease in the soil, or to sterilize situations from which diseased trees have been removed, by the application of

disinfectants to the soil. In cacao plantations in these islands lime has been frequently used, and, in Grenada especially, iron sulphate. One planter at least has used sulphur. So many factors are involved, and the circumstances are so variable that one cannot say what the actual effect of these applications has been.

Fawcett (1915) has experimented with lime, sulphur, chloronaphtholeum, copper sulphate, potassium permanganate, and potassium bisulphite. Plots which received in the one case lime and in the other sulphur at the rate of 500-grams per square metre showed no losses in three years, as compared with 6 per cent. of loss in a check plot, and 3 per cent. in a plot receiving about one-fourth the amount of sulphur, and another to which chloronaphtholeum was applied at the rate of about 50 c.c. per square metre. It was found that the last named substance was ineffective unless used in amounts involving a prohibitive expense. Spraying the surface of the soil with copper sulphate solution equivalent to 25 grams of the salt per square metre was sufficient to check and apparently exterminate the fungus in the soil of a small diseased plot.

Bernard (1909) quotes from Raciborski a method which he regards as having been successful against root disease of tea. It consist in working up the soil with quicklime and then watering it with a 10 to 15 per cent. solution of sulphate of ammonia; the idea being that ammonia is liberated in sufficient quantity to disinfect the soil.

Bordaz (1914) has claimed very successful results in Martinique from the use of carbon bisulphide emulsion. Trials of this substance in Dominica have failed to demonstrate its usefulness against root disease, although it has given apparently good results used against soil grubs.

For my own part I cannot see that there is much scope for the use of disinfectants in the control of this disease. It is safe to say that at the present time there is no disinfectant available which is cheap enough to be used in sufficient quantity to sterilize any considerable area of ground. When we are dealing with a fungus which penetrates to every part of even the thickest roots, it cannot be expected that chemical agents will kill it out, or, being necessarily of a transient nature, stop its progress, unless all woody material is removed. When this has been done, exposure of the soil to sun and air is probably just as effective as any disinfectant could be. Where it is required to deal with infested soil or accumulations of vegetable matter under shade, as for example in the case of the lime trees with surface infections specified above, it is better to scrape away the surface soil with a hoe than merely to extinguish the fungus with a disinfectant, leaving material liable to reinfection. Such a scraping of the soil combined with removal of low branches and of any other hindrances to the free circulation of air, has in the cases under my observation been sufficient. An application of lime, or sulphur, or according to Fawcett's results, of copper sulphate solution, would give an additional margin of safety.

The addition of lime to the soil when clearing up a spot from which infected trees have been removed is commonly practised, and is believed to contribute to success in establishing supplies. It seems to me probable that the results obtained are not so much due to the sterilizing effect of the lime as to its action in hastening the disappearance of

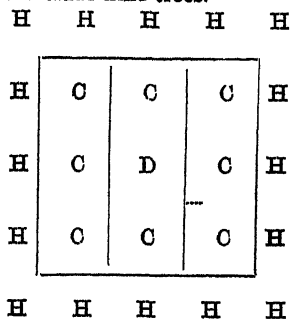
organic matter. There is a further probability that by neutralizing soil acidity lime produces conditions less suitable to the survival of the fungus.

If the view here taken of the function of lime is the correct one, the main effect may be obtained by the use of slaked lime, which is the only form that can be conveniently obtained in some islands. Quick-lime, because of its additional sterilizing effect, is to be preferred when equally available.

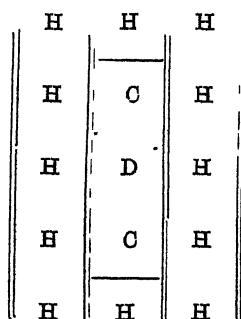
Where sulphur has to be imported, its price will not enable it to compete with lime, but there would appear to be possibilities in some places of obtaining it cheaply from local sources. Sulphur has a more definite fungicidal action than lime, and one which may be expected to develop slowly and have considerable persistence. In this connexion Fawcette (1915) reports an experiment in which a trench 4 x 4 inches was filled with soil mixed with sulphur, using about 15 grams of sulphur to each metre of trench. The fungus travelled through the soil to the edge of this barrier, but did not pass to the plants on the other side. A part of the trench which received no sulphur was crossed by the fungus.

The effect of sulphur on the soil reaction is to increase acidity, and from this point of view it is desirable to accompany or follow its application with an application of lime.

ISOLATION OF CONTACTS.*—The diseased tree having been removed, it is necessary to take steps to prevent the spread of the disease among the trees around. In a regular field, with ordinary distances of planting, the roots of the trees form a continuous system of contacts, interrupted only by the deep drains. By the time a tree is so far diseased as to be noticeable, the probabilities are great that the roots of one or more of the neighbouring trees have also become infected. It is required to cut the connexion between the infected roots and those of the surrounding healthy trees, and to break the continuity of the possibly infected surface soil. To be reasonably sure of doing this, it is necessary to carry an isolation trench outside the trees in contact with the one diseased. Thus in an undrained field, if D in the first diagram (I) represents a diseased tree, C the possible contacts, and H the healthy trees, the isolation trench should take the course indicated by the unbroken line, and will include nine trees.



I.



II.

* This section, with minor alterations, is reprinted from the author's pamphlet on diseases of lime trees. (No. 79, Imperial Department of Agriculture.)

Neither the roots of the trees nor the course of the disease follow regular lines, and it is quite improbable that all the eight contacts are infected, but there is no practicable means of knowing which remain free. In order to save those which are still uninfected, it is advisable to cut up the enclosed area chessboard fashion as indicated by the dotted lines. If these secondary trenches are omitted, it is likely that the contacts will all go off sooner or later in the manner already described.

In situations where there is a risk of soil infections the trees still further out, (H.. H in the diagrams), should have some special attention, especially if D is in an advanced case when discovered.

One lime planter in Dominica has anticipated events and has separated his trees throughout by trenches in both directions, so that each stand in a square plot cut off from the rest. This measure is regarded by the owner, and by Mr. G. A. Jones, who has reported on it from time to time, as having completely changed the prospects of the estate. Whereas the losses from root disease were becoming increasingly serious and were quite out of control, they are now reduced to occasional sporadic cases which cause no apprehension.

While few planters will be disposed to go so far as this except under pressure of heavy losses, there is much to be said for the general adoption of the system represented in the second diagram (II), where a permanent drain denoted (by a double line) exists between every row and the next. All that is required for isolation is the cutting of cross trenches between C and H, to separate contacts from healthy trees, and secondary cross trenches between D and C, to save the contacts if they do not prove to have become infected. The length of isolation trench required is reduced to one-sixth. It will be objected that the provision of the drains in the first instance involves much more expense, but apart from such purely agricultural benefits as may be obtained, the difference is a very practical one between cutting trenches in a systematic way, and at a convenient time, on the one hand, and on the other hand having to do it as an emergency measure, it may be at a time when it is highly inconvenient. It may be suggested that the expense of draining should be discounted by regarding it as a system of insurance, whereby from each sporadic case of disease which occurs, two trees only, instead of eight, are exposed to root infection. The adoption of such a system would prevent the development of the large open spaces, extending sometimes over the sites of dozens of trees, which are the most disquieting feature of clearings where this disease has become well established. There are arguments for this type of draining as a purely agricultural measure in wet districts, and there are instances in Dominica of its adoption on such grounds alone. The most serious objection I have heard urged against close draining in lime fields concerns the inconvenience and loss experienced in the collection of the crop, but I doubt if this comes near to balancing the advantages of the system. On steep slopes, of course, the trenching will have to be carried out with due regard to contours and the danger of slips and of wash; on all recent clearings there will be blocks due to large stumps. There are some situations where the method is quite out of the question, but they afford no argument against applying it where difficulties are

non-existent, or can be overcome. Like the preventive measures already indicated, it should be applied first of all in the situations where the losses are greatest, and extended as opportunity permits.

It is not necessary, from the point of view of root disease that the trenches should conduct water: indeed, where loss of surface soil by wash is feared more than the alternate danger of water-logging, it may be advisable deliberately to check their function in this respect. They may then be periodically cleaned out, and the deposit returned to the soil. It gives a clearer point of view if the system is regarded as one of permanent isolation trenches with a secondary function as drains, rather than as one of drains in the first instance.

Returning to consideration of the treatment of infected spots, there are two commonly existing situations which need to be dealt with. These are (1) the case where a large patch of trees has already been eaten out of a field, and the disease is spreading outward around its circumference, and (2) the case where one or more trees have been attacked around a large forest stump, infected or likely to become so, which together with its heavy roots prevents the cutting of trenches over an area which may include quite a number of trees. In both cases the procedure has to be modified to suit each individual set of circumstances, but still follows the simple principles set out above. Where roughly parallel main drains or watercourses exist on each side of the area, they should be joined across above and below to establish an outward limit, even though it may be a wide one, to the spread of the infection. Then working inward from this, successive trees or rows of trees which appear healthy may be separated off wherever it is possible to dig a trench, and the disease thus confined to the narrowest limits.

In the situations, sometimes met with, especially in cacao plantations, where the trees are growing amongst a confusion of fallen rocks, the possible measures are limited to early removal of so much of an infected tree as can be got at, and the liming of the soil about adjacent trees, with a view to preventing spore infections of the material which accumulates in the enclosed pockets of soil.

It has been commonly recommended that a trench be carried in a circle around diseased trees and their contacts. This method has practical disadvantages. The extent of the existing infection can never be ascertained by inspection and a wide circle, while enclosing many healthy trees may prove too narrow to include some line of infection that has run off in advance of the general spread. A circle leads nowhere, whereas a system of squares may be added to at any point and be carried in any direction, and is capable of any sub-division. It has moreover the great advantage of linking up with an existing or prospective drainage system.

As regards the form of the trench itself, there is but one essential so far as root disease is concerned: that it should be deep enough to cut through all the roots passing across its situation. When digging near an infected tree, the earth removed should be thrown inward as a precaution against the scattering of possibly diseased material among the healthy trees. This refers more particularly to secondary trenches; the outer trench should

be put far enough away to avoid, in general, the chance of finding such material. The earth should be distributed, not banked at the edge of the trench, unless put there in exceptional circumstances with the express purpose of avoiding wash. Under no circumstances, however, should the collar of the tree be earthed up. Roots passing into the healthy area should be followed up and removed, so far as this can be done without much injury to other roots. It would be well if cut ends of roots were painted.

SURVIVAL OF SUPPLY PLANTS.—On the thoroughness with which the clearing up is done depends the chance of survival of an early supply plant. It has been found in St. Lucia, where the results of several years of experience of the treatment of this disease on cacao are now available, that where the work has been carried out under the personal supervision of the planter, supplies put in a month afterwards have remained healthy. The longer the delay the greater the chance of survival. It must be remembered that a supply may do well for a few months while its roots occupy the site from which the stump was removed, and then become infected from some outlying fragment of the old tree as its roots spread wider. Such cases have been definitely traced.

THE POSSIBILITIES OF CONTROL.

Rosellinia disease in orchard cultivations is by its nature capable of the most serious consequences. It is cumulative in its effects: each tree that contracts it infects as a rule not merely one but several more, and each tree killed takes at least five or six years to replace. In new clearings, encumbered with stumps and logs, and in cacao fields with large shade trees, the disease is difficult to deal with.

It may be confidently claimed, however, that the application of the principles of prevention and control set out in the preceding pages will reduce the annual losses to a minimum that is not likely to be serious, and one may further expect a gradual diminution year by year of even the sporadic cases.

Control does not depend on any special apparatus or material, but on operations of a familiar type, demanding little special skill. Everything depends on the vigilance and thoroughness with which they are carried out. Careless or half-hearted work is of little use against this disease, which is apt to pursue its course with an appearance of deliberation and inevitability which is disconcerting.

SUMMARY.

Several species of the genus *Rosellinia* give rise to a well-defined type of root disease in numerous countries of the world, temperate and tropical. The fungus kills out cultivated trees or shrubs in patches, and often infests the soil and destroys practically all vegetation with which it comes into contact.

In the Lesser Antilles, *Rosellinia* diseases occur in Guadeloupe, Dominica, Martinique, St. Lucia, St. Vincent, and Grenada; they are unknown in the remaining islands of the group, which have drier climates.

The range of hosts is an exceedingly wide one, embracing practically all the important cultivated and semi-cultivated plants, but the cultivations most affected are those of cacao (in all the islands), coffee (in Guadeloupe and Martinique), limes (on new clearings in Dominica), and arrowroot (in the interior districts of St. Vincent).

The disease on cacao is usually caused by the species *Rosellinia Pepo*, and in most cases at the present time, the fields being well established, is communicated from the roots of dead or dying shade trees, especially breadfruit, avocado and pois-doux. Another species, as yet unidentified, is believed to attack cacao in certain localities.

The disease on limes and coffee is caused by *R. Pepo* or *R. bunodes*, indifferently.

The first cases in new clearings are usually associated with forest stumps left to decay, especially those of certain special trees. Subsequent cases arise from the spread of the fungus from tree to tree along the roots, or by infection from surface soil rich in decaying vegetable matter, which readily becomes infected in damp and shaded situations.

An infected tree may be killed gradually by the progressive investment of the roots, or rather quickly by the destruction of the bark around the collar. The fungus penetrates both bark and wood. Conidia are produced with great readiness wherever the mycelium emerges into the open: perithecia occur later, and especially in the case of *R. Pepo* their formation may be long delayed.

Much can be done to prevent outbreaks of the disease by measures directed towards exposing to wind and sun the soil, the bases of the trees, and any logs or other dead material lying about. Cases which arise may be restricted by these measures and by the provision of a close system of trenches to prevent root contact.

Treatment by excision and exposure is successful in the early stages of infection, but in practice these are hardly ever detected. Periodical surveys would save many trees.

Infected trees should be flamed and then promptly removed, all roots dug out and burnt, the soil limed, and the situation exposed as much as possible. All adjacent trees should be isolated from each other by trenches.

SUGAR.

VARIETIES OF CANE UNDER ESTATE CULTIVATION
IN TRINIDAD, FOR THE CROP OF 1919.

At the meeting of the Board of Agriculture in February, 1919, Mr. W. G. Freeman proposed and Mr. J. W. Arbuckle seconded the following motion, "That it is desirable that an annual return be obtained showing the acreage under estate cultivation of the principal varieties of sugar cane, and their yield per acre."

A Circular was sent in March to all the sugar estates asking for the information, and suggesting that, if practicable, canes on heavy and light soils should be reported separately, and that the weight of canes per acre, and also the yield of sugar per acre should be given for each variety.

Mr. J. de Verteuil has compiled a summary of the returns furnished by planters. Although these were received from nearly all the estates or groups of estates in the Colony it would appear, that with few exceptions, they are very incomplete. It has been found impracticable to differentiate between the canes grown on light and heavy or black and red soils respectively.

SUGAR-CANE RETURNS CROP 1919.

Variety.	Description.	No. of Estates reporting.	Area under cultivation.	CANES PER ACRE. Average Yield of Estates.		
				Highest.	Lowest.	General Average.
			acres.	tons.	tons.	tons.
B. 156	Plant Canes ..	9	1404.0	30.1	14.0	20.5
	First Ratoons ..	7	1140.1	21.4	13.6	17.6
	Second and other Ratoons ...	6	1484.5	15.6	8.0	12.3
D. 109	Plant Canes ..	8	1118.4	23.0	15.0	19.1
	First Ratoons ..	7	577.9	20.0	8.2	16.1
	Second and other Ratoons ..	3	490.8	18.0	8.5	10.4
B. 347	Plant Canes ..	2	456.4	30.0	23.9	24.7
	First Ratoons ..	2	288.7	15.7	15.5	15.6
	Second and other Ratoons ...	2	113.8	12.3	10.9	12.2
B. 6450	Plant Canes ..	5	159.3	26.0	20.0	23.1
	First Ratoons ...	3	227.2	21.4	14.8	17.0
	Second and other Ratoons ...		209.4	14.1	6.7	13.4
Bourbon	Plant Canes ..	2	81.5	20.0	17.7	17.7
	First Ratoons ...	3	114.5	19.0	12.0	16.5
	Second and other Ratoons ...	4	333.0	17.0	10.0	11.1

SUGAR-CANE RETURNS CROP 1919—*Continued.*

Variety.	Description.	No. of Estates reporting.	Area under cultivation.	CANES PER ACRE. Average Yield of Estates.		
				Highest.	Lowest.	General Aver'ge.
			acres.	tons.	tons.	tons.
Uba.	Plant Canes ...	1	91.0	...	...	26.5
	First Ratoons ...	1	147.8	..	..	17.2
	Second and other Ratoons ..	1	73.0	...	...	13.2
B. 1753	Plant Canes ...	2	125.7	35.5	23.8	25.7
	First Ratoons ...	2	72.7	16.5	16.2	16.2
	Second and other Ratoons ...	2	26.7	16.6	10.0	15.6
D. 116	Plant Canes ...	2	66.0	20.6	16.5	17.4
	First Ratoons ...	2	48.7	15.9	8.7	15.3
	Second and other Ratoons ...	2	31.0	13.6	8.8	12.2
B. 6308	Plant Canes ...	4	87.5	31.0	15.3	24.8
	First Ratoons ..	2	33.4	24.3	15.4	21.7
	Second and other Ratoons ...	1	5.1	...	...	16.0
B. 376	Plant Canes ...	2	25.5	30.0	25.2	26.4
	First Ratoons ..	2	27.5	22.0	15.4	19.7
	Second and other Ratoons ...	2	30.1	20.0	10.2	17.4
Hill Seedling	Plant Canes ..	1	20.0	...	...	25.8
	First Ratoons ...	1	14.0	...	...	19.7
	Second and other Ratoons ..	1	51.7	...	...	17.4
Venezuelan Bourbon	Plant Canes ...	1	8.0	...	...	21.6
	First Ratoons ...	1	41.6	...	...	17.1
	Second and other Ratoons ...	1	30.3	...	...	15.6
Egyptian	Plant Canes ..	1	14.2	...	...	23.7
	First Ratoons ...	1	20.5	..	...	16.5
	Second and other Ratoons ..	1	26.0	...	...	11.1
Antigua	Plant Canes ..	1	47.5	..	..	24.1
	First Ratoons ...	1	5.0	...	...	18.0
	Second and other Ratoons ..	..	...	...	...	...
Louisiana	Plant Canes ...	2	45.0	15.0	15.0	15.0
	First Ratoons ...	1	2.0	..	...	14.0
	Second and other Ratoons ..	...	..	...	..	...
Brazil Rosa	Plant Canes ..	1	2.7	...	..	14.1
	First Ratoons ...	1	28.5	...	...	13.1
	Second and other Ratoons ...	1	11.5	..	..	11.3

SUGAR-CANE RETURNS CROP 1919.—*Continued.*

Variety.	Description.	No. of Estates reporting.	Area under cultivation.	CANES PER ACRE. Average Yield of Estates.		
				Highest.	Lowest.	General Aver'ge.
			acres.	tons.	tons	tons.
Badilla	Plant Canes ...	1	5.5	.	...	21.3
	First Ratoons ...	1	10.0	..	...	32.3
	Second and other Ratoons ..	1	22.0	..	..	11.8
B. 147	Plant Canes ...	1	18.0	...	...	20.0
	First Ratoons ...	...	...	...	...	..
	Second and other Ratoons ..	1	8.0	...	...	9.7
Foster's Beauty	Plant Canes ...	1	7.0	.	...	27.0
	First Ratoons ...	1	5.0	..	...	13.0
	Second and other Ratoons ...	1	8.0	..	..	18.0
B. 3412	Plant Canes ..	1	1.0	...	..	20.0
	First Ratoons ...	...	...	...	..	...
	Second and other Ratoons ...	1	14.0	..	...	18.9
B. 306	Plant Canes ...	1	1.0	...	...	28.0
	First Ratoons ...	...	...	...	..	...
	Second and other Ratoons ..	1	2.0	...	...	18.0
Ba. 6032	Plant Canes ..	3	53.9	...	...	25.4
B. 16832	Plant Canes ...	1	18.0	..	..	29.0
B. 4934	Plant Canes ...	2	17.0	..	...	28.7
B. 6835	Plant Canes ..	1	9.0	...	..	27.0
B.C. Seedling.	Plant Canes ..	1	6.0	...	...	26.7
B. 6388	Plant Canes ...	1	5.7	...	...	21.6
B. 3390	Plant Canes .	1	1.0	...	..	10.0
D. 464	First Ratoons ...	1	6.0	..	..	17.6
D. 4395	First Ratoons ...	1	5.0	...	..	10.5
D. 625	Second and other Ratoons ...	1	10.0	...	..	19.0
B. 3922	Second and other Ratoons ...	1	2.4	...	..	15.0

From this table it will be seen that the most popular cane is B. 156. to the above acreage must be added 520 acres in plant canes from one estate, 182 and 429 acres in first and second ratoons respectively from two estates which did not report the tonnage of canes reaped per acre.

D. 109 comes next and to the acreage given in the table above must be added 433, 475 and 172 acres for plant canes, first and second ratoons respectively from an estate which did not give the tonnage per acre. Not only is B. 156 more extensively cultivated but it has also given better returns than D. 109.

B. 847 and B. 6450 come next but on a much lower acreage and with slightly better results than either B. 156 and D. 109.

From the returns it would appear that the area planted in Bourbon is being reduced yearly.

The area under cultivation for B. 1753 and B. 6308 is slowly increasing and it will be observed that on the limited area planted they have given better results than B. 156. D. 116 and B. 376 have not made much progress.

Ba. 6032 has been planted on three estates and from 53.9 acres in plant canes an average yield of 25.4 tons of cane per acre has been reported.

All the other varieties have been planted on only one estate or group of estates.

FORESTRY.

DURABILITY TESTS WITH INFERIOR LOCAL WOODS.

By H. W. Moor.

Deputy Conservator of Forests, Trinidad and Tobago.

Tropical forests are, with very few exceptions, invariably of a mixed nature, the more valuable species forming a very small proportion of the entire crop, the overwhelming majority of species being, what has usually been classed as useless. It is maintained, and has been amply proved in other countries where Economic Forestry has made appreciable progress, that the woods of nearly all species, however useless and inferior they may have been considered in the past, are each peculiarly adapted to some definite purpose, nearly all being useful species and as such, not to be cut out and destroyed indiscriminately, as is the existing custom in Trinidad.

The natural result of the advance of agriculture in this colony has been the destruction of large tracts of forests with a proportionately increased demand for the better class woods, such as cedar, balata, &c., for building and other purposes. This demand, following immediately on a period of unrestricted timber cutting, has placed an abnormal strain on the supply of these species; consequently the existing forests have been considerably changed in character, the better woods often being conspicuous by their absence. Trinidad is now largely dependant on imported lumber, chiefly from a foreign country, a state of affairs which has, from the experience of the last five years, been found to be very unsatisfactory.

In view of the above, and also on account of the fact that the world's timber supply is considerably below the demand and will remain so for the next half century, it has become the business of the Forest Department of Trinidad to find substitutes for the depleted supply of good local woods (until such times as existing plantations mature), and to meet the shortage of imported lumber.

The difficulties to be contended with in connection with tropical woods are that they are more subject to warping, splitting and cracking than imported coniferous woods, and are also subject, in a very marked degree, to insect attacks before they are seasoned and ready for use.

With a view to surmounting the above difficulties two series of experiments are being carried out, one with the object of seasoning timber standing, thus obviating uneven drying and consequent warping and splitting, and, by means of a poison, to prevent insect attacks; the other, the subject of this paper, by artificial seasoning and subsequent immersion in crude oil.

Six of the most inferior and least durable species were selected to experiment on, the reason for their selection being that the results may be obtained in the shortest possible time. The species, viz :—

Hog Plum.—*Spondias lutea*, L.

Mahoe.—*Sterculia caribaea*, R. Br.

Jiggerwood.—*Bravaisia floribunda*, D.C.

Bois Lais Lais.—

Silk Cotton.—*Eriodendron anfractuosum*, D.C.

Chataigne.—*Pachira insignis*, Sav.

were each sawn into three sets, each set consisting of one log, one plank and one board. One set of each kind was placed untreated in a shed, the other two sets being immersed in water immediately after sawing and left there for six weeks. On removal from the pond these sets were left in a drying shed for three months, at the expiry of which one water seasoned set of each was immersed in crude oil for a period of one week. There is now one set of each species untreated, one set water seasoned, and one set water seasoned and oiled, to experiment on.

The object of the water-seasoning is to prevent insect attacks by washing out all the wood saps, the food supply of insects and fungus, and at the same time to season timber against warping, etc., by more even drying; the oiling being to protect the surfaces the better to withstand weathering influences, also as an additional barrier to insect attacks, and to prevent fungoid diseases.

The following table gives the time in days, that elapsed between felling the trees and the final putting out of the converted pieces for the durability-test, also the time taken for each stage of the treatment.

Identifying Letter.	Species.	Untreated Pieces Nos. II, V & VIII.	Water-seasoned Pieces Nos. I, IV & VII.			Water-seasoned and Immersed in Crude Oil Pieces Nos. I, III & VI.				
		Days in shed.	Days in water.	In drying shed.	Total.	Days in water.	In drying shed.	In crude oil.	In drying shed.	Total.
A	Hog Plum...	274	45	229	274	45	90	8	131	274
B	Mahoe ...	268	45	223	268	45	90	8	125	268
C	Jiggerwood...	266	45	221	266	45	90	8	123	266
D	Bois Lais Lais.	271	45	226	271	45	90	8	128	271
E	Silk Cotton..	272	45	227	272	45	90	8	129	272
F	Wild Chataigne.	257	42	215	257	42	90	8	117	257

N.B.—Nos. I & II of each species are logs 12' x 10" x 10". No. I was first water-seasoned, then cut in half, and one half oiled. No. II is untreated.
 Nos. III, IV & V are planks 12' x 12" x 3". No. V is untreated, No. IV water-seasoned and No. III water-seasoned and oiled.
 Nos. VI, VII & VIII are boards 12' x 12" x 1'. No. VIII is untreated, No. VII water-seasoned and No. VI water-seasoned and oiled.

The pieces were put out on September 9, 1919, according to species, and in exactly similar positions, under severe weathering conditions, on a site in the St. Clair Experiment Station kindly lent to the Forest Department by Mr. W. G. Freeman, Director of Agriculture, for the final durability test.

The experiment is by no means complete, in that slightly modified treatment may be necessary for individual species, nor is it on a commercial scale; but if, as is expected, sufficiently valuable data is obtained, regarding the comparative durability of treated and untreated pieces, to make a larger attempt worth while, it will certainly prove of great benefit to the Colony, especially as crude oil is obtainable in sufficient quantities in all our accessible forests.

The thanks of the Forest Department are due to Mr. P. C. Bird, late Manager of the Trinidad United Oilfields Co., Ltd., at Palo Seco, who very kindly and thoroughly carried out the initial stages of the experiment in cutting and treating the timber.

November 18, 1919,

LIVE STOCK.

"NELSWEEP," RECENTLY IMPORTED THOROUGHBRED.

Mr. H. H. Hunn was recently commissioned by the Department to purchase a Thoroughbred stallion in the United States for the Government Farms of the Colony. The new stallion "Nelsweep" arrived in November 1919, and copies of the certificate of exportation and of his pedigree are appended:—

THE JOCKEY CLUB.

CERTIFICATE OF EXPORTATION.

No. 1804.

of a *Thoroughbred Race Horse* into Trinidad, B.W.I., for Racing
and Breeding Purposes,

This is to certify that the bay or brown colt foaled March 20, 1915, named 'Nelsweep' by 'Sweeper' out of 'Lady Nell' by 'Mordant' is duly registered on Vol. XII. when published of American Stud Book.

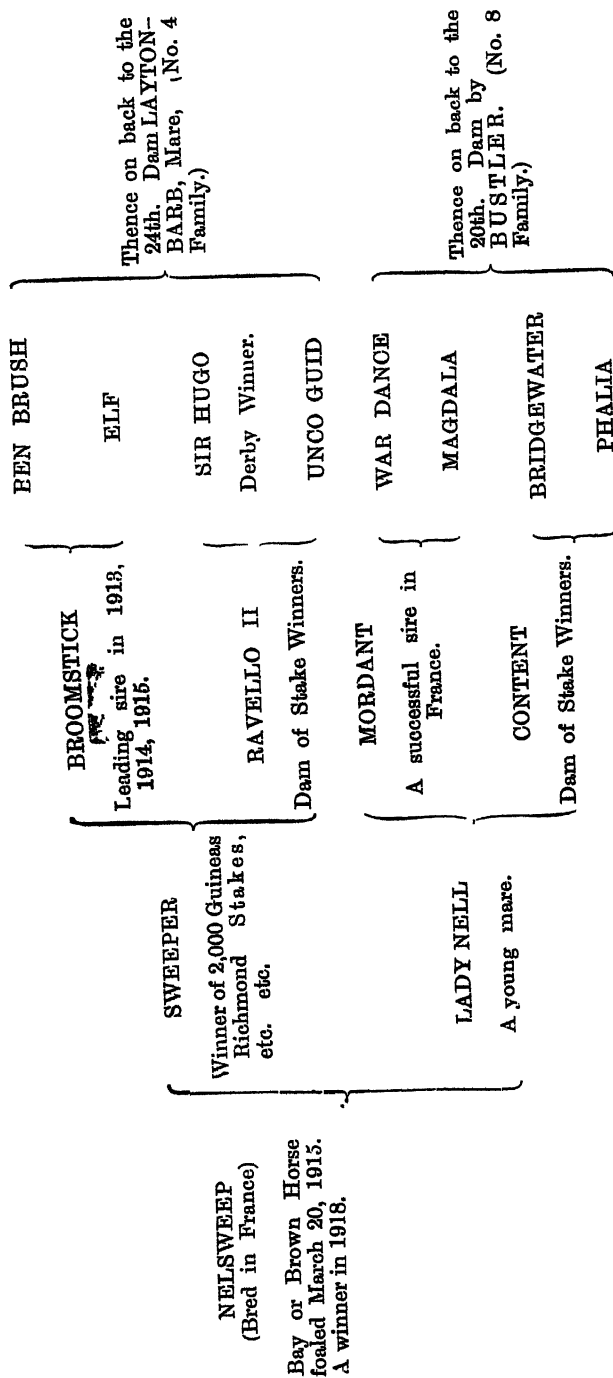
MARKS: Irregular star, small stripe on nose, running between nostrils, few white hairs on off hind coronet.

(Signed.) F. K. STNIGIS,
Secretary.

W. H. ROWE,
Registrar.

Issued to H. H. HUNN,
New York, October 10, 1919.

Pedigree of "Nelsweep."



AGRICULTURAL EDUCATION.

VEGETABLE PRIZE COMPETITIONS, TOBAGO, 1919.

The Regulations of the Vegetable Prize Competitions in Tobago for 1919 were printed in the *Bulletin* XVIII. 1919, 39-40. The work has been under the charge of Mr. F. D. Davies, the resident Agricultural Adviser, and the final judging was conducted by the Rev. Wm. de la Rosa and Mr. Davies. Mr. de la Rosa, who takes a keen interest in the work of the peasantry, suggested, in offering his services as a judge, that he did not wish any remuneration, and any money thus rendered available might be spent when opportunity offered in additional prizes for Tobago. The judges recommended extra prizes in the yam and sweet potato classes (*see* report) and these were given.

Each prize winner and also those who earned special mention received a certificate, signed by His Excellency the Governor, and the Vice-President and Secretary of the Board of Agriculture. These were presented by the Director of Agriculture at the Agricultural Exhibition at Scarborough on December 5, 1919.

W. G. F.

REPORT OF THE JUDGES.

We beg to submit our Report on the judging of the Vegetable Prize Competition of Tobago. We began on the 15th of October and finished on the 30th.

There were 84 entries for competition. After inspection of all gardens by the Agricultural Adviser, weeks before, the best plots were selected, 52 in number. The work of selection was most thorough and impartial, and the gardens were distributed all through the Island, at widely distant points from each other. Some were at the highest elevations, almost inaccessible and somewhat dangerous: and difficulties were increased by bad weather.

To simplify judging we gave marks under four headings:—Tillage 30, Manuring 20, Systematic 30, General 20, making a total of a possible hundred marks.

Those entitled to prizes are:—

Class I.—YAMS.

John R. Henry	..Golden Lane	...First Prize—98 marks.
Leoni Hercules	...Merchiston	...Second „ 94 „
T. A. Hector	.. Mt. St. George	...Third „ 90 „

Class I. A.—POTATOS.

C. H. Dann	.. Pembroke	...First Prize—98 marks.
Prince Stewart	...Shore Park	...Second „ 95 „
W. Archie	. King Peter's Bay	...Third „ 93 „

Class II.—PLANTAINS, TANIAS.

R. J. Douglas	...Cradley	...First Prize—95 marks.
Wm. Sharper	...Englishmen's Bay	...Second „ 94 „
Samuel Young	...Goodwood	.. Third „ 92 „

Class III.—RICE.

P. Drayton	...Auchenskeoch	.. First Prize—96 marks.
Alex. Thompson	...Bloody Bay	...Second „ 93 „
C. M. Thoms	...Parlatuvier	...Third „ 88 „

Referring to Class I. A. we found that some of the Yam and Potato gardens were too good and extensive to judge with fairness on the alternative: the condition of competition being one quarter acre of yams or one quarter acre of potatoes. We have, therefore, taken the liberty of placing potatoes in a separate class, and now ask the Board to be good enough to award special prizes. We would suggest prizes of \$10, \$6, and \$4, making a total of \$20 extra. The potato is one of the staple crops of the Island, and the people need some special encouragement in better methods of cultivation of this food.

Permit us to remark, that, of equal soil and cultivation, a quarter acre of yams is of greater commercial value than a quarter acre of potatoes; and to make the potato the alternative of the yam would seem somewhat unfair, especially when we found excellent plots of both, quite above the average. For instance: The winner of the First Prize in Class I, Yams 98 marks, has a wonderful plot of about 2,590 plants, yielding some tremendous yams. The winner of First Prize in Class I. A, Potatoes—98 marks—has a wonderful plot of potatoes, of equal size, soil and cultivation. They both deserve, proportionately, good prizes. The same principle holds good with other winners in Classes I and I. A.

May we suggest for special mention the following:—

<i>Class I.</i>	—C. H. Dann	...Pembroke	.. 87 Marks.
	Prince Stewart	...Shore Park	... 86 „
	B. J. Joseph	.. Salem ..	... 86 „
<i>Class I. A.</i>	—P. Drayton	...Auchenskeoch	.. 92 „
	A. Hector	...Mt. St. George	... 88 „
	B. Joseph ...	...Fort Hill ...	... 88 „
<i>Class II.</i>	—W. Archie..	...King Peter's Bay	.. 91 „
	Peter Forster	...Roxborough	.. 89 „
	S. Thomas...	...Cradley ...	... 88 „
<i>Class III.</i>	—James Tobias	...Belle River	.. 86 „

(Sgd.) W. DE LA ROSA.

F. D. DAVIES.

November 8, 1919.

AGRICULTURAL LEGISLATION.

FARMERS' ADVANCES (AMENDMENT)
ORDINANCE, 1919.

TRINIDAD AND TOBAGO.

No. 9—1919.

I ASSENT,

[L.S.]

W. M. GORDON,
Acting Governor.

May 18, 1919.

AN ORDINANCE to amend the Farmers' Advances Ordinance, 1918.

[May 18, 1919.]

BE it enacted by the Governor of Trinidad and Tobago with the advice and consent of the Legislative Council thereof as follows:—

1. This Ordinance may be cited as the Farmers Advances (Amendment) Ordinance, 1919.

2. Notwithstanding anything to the contrary contained in Section 8 of the Farmers' Advances Ordinance, 1918, an advance note and the duplicate thereof shall be deemed to have been and to be duly signed by the parties thereto within the meaning of such section if such note and duplicate shall be signed by the person making the advance or his manager, or any other person authorised by him or his manager to sign such note and by the Farmer, and notwithstanding that such authorization shall not have been in writing; an advance note so signed shall be held to have been and to be good and effectual for all the purposes of the Farmers' Advances Ordinance, 1918.

3. Nothing in this Ordinance shall be construed so as to affect the title to or property in any canes delivered after the twenty-sixth day of November, 1918 and before the commencement of this Ordinance by any farmer who is party to an advance note not executed by the person making the advance in accordance with the requirements of Section 8 of the Farmers' Advances Ordinance, 1918.

Passed in Council this Second day of May, in the year of Our Lord one thousand nine hundred and nineteen.

J. M. FARFAN,
Acting Clerk of the Council.

IMMIGRATION (AMENDMENT) ORDINANCE, 1919.

TRINIDAD AND TOBAGO.

No. 12¹—1919.

I ASSENT,

[L.S.]

W. M. GORDON,
Acting Governor.

June 2, 1919.

AN ORDINANCE to amend the Immigration Ordinance, 1916.

[June 2, 1919.]

BE it enacted by the Governor of Trinidad and Tobago with the advice and consent of the Legislative Council thereof as follows:—

1. This Ordinance may be cited as the Immigration (Amendment) Ordinance, 1919,

2. The Immigration Ordinance, 1916, is hereby amended as follows:—

- (1.) In sub-section (1) of section 94, after the word "hospital" in the seventh line shall be read the words "and the enclosing of the same with a sufficient fence with all necessary gates and locks."
- (2.) In sub-section (3) of section 94, after the word "hospital" in the second line shall be read the words "nor any alteration of the fencing or gates."
- (3.) In sub-section (1) of section 96, after the word "reason" in the fourth line shall be read the words "(including the want of proper fencing or gates)."
- (4.) In sub-section (2) of section 96 after the word "hospital" in the second line shall be read the words "or that it is not enclosed with a sufficient fence with the necessary gates and locks," and after the word "Ordinance" in the eighth line shall be read the words "or enclose the same with a sufficient fence with the necessary gates and locks."

Passed in Council this Sixteenth day of May, in the year of Our Lord one thousand nine hundred and nineteen.

J. M. FARFAN,
Acting Clerk of the Council.

THE TRUCK ORDINANCE, 1918.

This Ordinance, No. 84 of 1918, to prohibit the payment of Wages otherwise than in Money, has already been published in the *Bulletin*, XVIII. 1919, 104-05.

His Excellency the Governor, by Proclamation No. 60 of 1919 (November 25) has fixed January 1, 1920 as the date on which it comes into operation.

RE-ORGANIZATION OF THE DEPARTMENT AND BOARD OF AGRICULTURE.

On October 25, 1918, His Excellency the Governor laid before the Legislative Council proposals for the re-organization of the Department and Board of Agriculture of the Colony. These proposals, which had already received the general approval of the Secretary of State for the Colonies, were adopted by the Council and an Ordinance to give effect to them was subsequently passed. The despatch of the Governor to the Secretary of State, forming part of *Council Paper* No. 112 of 1918, gives a concise summary of the existing organization and the broad lines of future development, and is reproduced below together with the Ordinance which by Proclamation 59 of 1919 came into effect on January 1, 1920.

Despatch from the Governor to the Secretary of State for the Colonies.

TRINIDAD.—No. 898.

GOVERNMENT HOUSE,
November 1, 1917.

Sir,

With reference to paragraph 4 of my despatch No. 232 of June 26, 1917, I have the honour to state that I have been examining into the question of the organization of the Department of Agriculture, and although I do not propose to make important changes until the new Director has been appointed, I submit for your consideration the following suggestions for the re-organization of the Department and Board.

2. The present position is not altogether satisfactory. Personal considerations to which it is not now necessary to refer were in a large measure responsible for the creation of a Department and a Board of Agriculture independent of one another and with more or less competing activities. Apart from the friction that such an arrangement almost inevitably created it has also tended to a diffusion of effort which has prevented full value from being obtained from the considerable sum that is expended annually in the colony for the advancement of Agriculture.

It is therefore highly desirable that the Department and Board should be brought into closer relationship than they are at present and that their organization should be simplified. Before submitting recommendations to effect these objects I shall first describe the present organisation of the Department and Board of Agriculture, and refer briefly to the other establishments in the Colony connected with the agricultural and stock breeding industries.

DEPARTMENT OF AGRICULTURE.

3. The establishment of a Department of Agriculture was approved by a Resolution of the Legislative Council of 16th March, 1908, (*vide* Council Paper No. 120 of 1908). The scheme for the establishment of

the new Department was drawn up by Sir Henry Jackson whose original intention was that the Department of Agriculture should be under the control of a Director assisted by an advisory Board. The Board was to advise the Government as to the operations of the Department and the duties of its officers, and from time to time to appoint and pay from the funds at its disposal specially selected officers to strengthen any particular branch of the Department that the Board might consider in need of temporary assistance. Those officers while so employed were to be under the sole direction of the Director of Agriculture, but the arrangement of their duties and the duration of their employment was to be entirely in the hands of the Board.

On its establishment in 1908, there were embodied in the new Department of Agriculture the then existing Botanical Department, the Government Laboratory, the Government Stock Farms and the River and St. Augustine Estates.

Professor Carmody, who was appointed Director retained the post of Government Analyst and Professor of Chemistry to the Queen's Royal and St. Mary's Colleges which he then held. This arrangement was however little more than nominal, for subsequent to his appointment as Director of Agriculture Professor Carmody only exercised a general supervision over the work of the Laboratory and gave no lectures in chemistry to the students of the Colleges. The work of the Government Laboratory includes analytical work in connection with police, customs and public health matters in addition to purely agricultural work, and the building also contains class rooms used by the students of the Queen's Royal College.

BOARD OF AGRICULTURE.

4. When the resolution of the Council approving the creation of a Department of Agriculture was adopted a Committee of eight members, five of whom were members of the Legislative Council, was appointed to advise as to the staff of the new Department. The Committee made recommendations in regard to the taxes which, at the instance of the Agricultural Society, were to be imposed on exported produce to assist in meeting the increased cost of the new Department, and expressed strong disapproval of the arrangement then contemplated under which the proceeds of the Agricultural Tax were to be paid into the Treasury. They contended that if the proceeds of the tax were included in the general revenue of the Colony, the Board of Agriculture would lose control of its funds, and they urged that the money should be paid into an account to the credit of the Board, who should have complete control over the expenditure. In view of the strongly expressed wishes of the members of the Committee this arrangement was approved by Lord Crewe on the understanding that the Government would not be bound to act upon the advice of the majority of the Board, except with regard to the disposal of the special Agricultural Fund.

5. The Department of Agriculture was not formerly established by law, but Ordinance No. 35 of 1908 provided for the establishment of a Board of Agriculture consisting of the Governor, the Director of the Department of Agriculture and not less than twelve or more than twenty persons to be appointed by the Governor and representing the

agricultural industries of the Colony. The powers and duties of the Board, as laid down in that Ordinance and subsequent amending Ordinances are to advise the Director of the Department of Agriculture as to all matters and questions submitted to them by the Department of Agriculture and to appropriate the funds of the Board for the purpose of making experiments and research, and collecting such information as they may think important for the purposes of agriculture, including in such purposes the introduction of any new agricultural industry and methods for dealing with insect, fungoid and other pests and for the collection and distribution of agricultural statistics. Provision is made for the establishment of an Agricultural Fund to be administered by the Board; and the Board is empowered to appoint a Secretary and such officers as it may require and to pay them out of the Agricultural Fund such salaries as may be determined by the Board with the consent of the Governor.

6. When the Board of Agriculture was established the proceeds of the Agricultural Tax, amounting to about £3,000 a year, were paid into the Colonial Bank to a separate account to the credit of the Board, and the Director of Agriculture dealt with the routine business of the Board in the same way as with that of the Department. A Mycologist and Entomologist were engaged by the Board in 1908. They were paid by the Board but worked under the supervision of the Director of Agriculture. In September 1909 the Assistant Director was made Secretary to the Board, and in February 1910 at the instance of some members of the Board the Mycologist and Entomologist were removed from the control of the Director and placed under the Assistant Director of Agriculture who was made Chief Executive Officer as well as Secretary to the Board. In August 1910 on the death of Mr. Carruthers Assistant Director, the Mycologist became Chief Executive Officer of the Board and the post of Secretary was made a separate appointment. At the end of 1915 the post of paid Secretary was abolished, and the Mycologist became honorary Secretary in addition to his duties as Chief Executive Officer of the Board. He is now charged with the supervision of the work of its officers and is also responsible for all payments made on account of the Board.

7. In addition to the Mycologist and Entomologist the Board of Agriculture pays part of the salary of the Superintendent of Field Experiments—an officer of the Department of Agriculture—who carries out manurial and other experiments on behalf of both the Board and the Department. The Superintendent of Field Experiments has a clerical assistant who is paid partly by the department and partly by the Board of Agriculture.

The staff of the Board also includes a Laboratory and Field Assistant and five Agricultural Inspectors (now called Agricultural Advisers) whose salaries are paid from the funds of the Board, but who with the sanction of the Board work under the control and orders of the Director of the Department of Agriculture. The Agricultural Advisers visit the small proprietors and advise them as to methods of cultivation and as to the prevention and cure of diseases. They also act as Inspectors under the Plant Protection Ordinance.

In addition to these activities the Board organises competitions and offers substantial prizes to small proprietors and contractors for cocoa and other cultivation. The competitions arouse keen interest among those eligible to enter for them, and have led to a marked improvement in the methods of cultivation used by peasant cultivators.

OFFICES OF DEPARTMENT AND BOARD.

8. The office of the Director of Agriculture is in Government Buildings, Port-of-Spain. The Assistant Director has his office at the St. Clair Experimental Station, and the Government Laboratory is situated near the Princes Building. The officers of the Board of Agriculture are accommodated at the St. Clair Experimental Station, but the building there is small and inconvenient, and the offices are so overcrowded that their work is thereby seriously hampered.

ST. AUGUSTINE ESTATE.

9. The St. Augustine Estate comprising 3,785 acres was purchased by Government in 1900 for £9,145. The estate was acquired to provide a Central Yaws Hospital, a Rifle Range, a Cemetery and a Government Farm to take the place of a farm at St. Clair which, being situated in the neighbourhood of the Savannah the most favoured residential quarter of Port-of-Spain, had become of considerable value for building purposes.

The estate was at first managed by a Manager working under the supervision of the Colonial Secretary. Separate accounts were kept, and the estate was worked as a business concern.

When the Department of Agriculture was formed in 1908, the supervision of the estate was transferred from the Colonial Secretary to the Director of Agriculture, but no change was made in the methods of management or system of accounts.

BOARD OF MANAGEMENT.

10. In 1918 in consequence of certain irregularities which had occurred in connection with the accounts of the estate a Committee was appointed to enquire into the system of management. On their recommendation a new system of book keeping and audit was adopted with a view to establishing an efficient control over the financial transactions of the estate, and a Board of Management, composed of three persons, including the Director of Agriculture, was appointed to manage the estate.

At the end of 1918 a Select Committee of the Legislative Council was appointed to enquire into the management of the St. Augustine and River Estates. The Committee recommended no change in the system of management by a Board, but in paragraph 25 of their report they stated that:—

“There does not appear to be any particular advantage in omitting St. Augustine and River Estates from the Annual Estimates and consequently from the accounts of the Colony kept by the Receiver-General, unless it is for the purpose of allowing a complete system of accounts to be kept, in which case the estates would pay the land, house and other taxes to the Government and receive Payment therefrom for such parts of either of the estates, *e.g.* the Government Farm and the Yaws Hospital, as are occupied by Government Departments.”

11. No change was made in the system of accounting in consequence of that recommendation except that St. Augustine Estate has since then received substantial sums in rent from the Government Departments which use lands or buildings forming part of the estate. The Department of Agriculture, for example, pays £187 10 0 per annum as rent of the Government Stock Farm, Valsayn, and £37 10 0 as rent of the experimental plots of 25 acres. The Medical Department pays £125 per annum as rent for the Yaws Hospital. The Board of Management of the Estate has no connection with the stock farm which is under control of the Director of Agriculture assisted by an Advisory Committee of the Board of Agriculture. The Manager of the St. Augustine Estate is, however, also Manager of the Government Stock Farm so that he has dual functions, two office establishments, and is responsible to two authorities.

12. As an example of the confusion and overlapping of authorities existing under present conditions, it may be mentioned that at St. Augustine Estate experiments in sugar cultivation are now carried on, under the control of the Department of Agriculture, in some of the plots, and in neighbouring plots under the control of the Board of Agriculture; while the Board of Management of the Estate also cultivates an area of about 50 acres of canes with the object of obtaining information as to the yield per acre from different varieties of canes and the cost of cultivation under estate conditions. There are thus three independent authorities engaged in the experimental cultivation of sugar canes on St. Augustine Estate.

13. Since the estate was acquired by Government about 2,000 acres have been disposed of by sale on 999 years lease, including 1,000 acres recently leased to Messrs. Nelson and Sons for the cultivation of bamboos for the manufacture of paper pulp.

The estimated expenditure on the estate for 1917 is £2,996 and the estimated revenue £3,183. The money advanced by Government for the purchase of the estate has been repaid and it is estimated that the surplus on the 31st December will be £6,711 19 0, so that the estate has proved to be a profitable investment.

RIVER ESTATE.

14. The River Estate was purchased for £4,629 in 1897 with the object of improving the water supply of Port-of-Spain. The property which has an area of about 1,500 acres is situated in the basin of the Diego Martin Valley, seven miles from Port-of-Spain. A pumping station belonging to the City Council by which water is drawn from wells for the supply of Port-of-Spain is situated on the estate. Owing to the estate being in the hands of Government the catchment area is secured from serious pollution, but otherwise the River Estate is in no way made use of for the water supply of Port-of Spain.

In 1899 the River Estate was leased for a term of years at an annual rental of £375. This arrangement was found unsatisfactory, and in 1903 the lease was determined and the management of the estate entrusted to the Botanical Department.

In 1908 the estate was absorbed in the Department of Agriculture, and came under the control of the Director. In 1909 the Board of Agriculture recommended that the River Estate should be worked on a suspense account in the same way as St. Augustine Estate and that the revenue of the estate, after payment of expenses, should be set apart for experiments in cocoa cultivation. Up to that time the receipts and expeniture of the estate had been included in the annual estimates of the Colony. In 1910 effect was given to the recommendation of the Board of Agriculture and the estate is now worked as a business concern with separate accounts like the Augustine Estate.

In 1913 the management of the River Estate was transferred from the exclusive control of the Director of Agriculture to the Board of Management to which reference is made in paragraph 10 above.

The estimated expenditure on the estate for the year 1917 is £3,587 and the estimated revenue £4,523. The money advanced for the purchase of the estate has been repaid to Government and the estimated surplus in the accounts of the estate on 31st December, 1917, is £2,484. With the extension of cultivation and improvements affected the present value of the estate is estimated to be about £25,000.

15. In connection with St. Augustine Estate the Board of Management is largely occupied with transactions connected with the sale and lease of the land belonging to the estate, with the management of the Mount Hope Cacao Estate, and with the cultivation of sugar and other crops on part of the estate.

16. In addition to the control of the estates the Board of Management has charge of the Agricultural Pupil Scheme the expenses of which, amounting to about £150 a year, are borne by the funds of the River Estate.

GOVERNMENT STOCK FARM, VALSAYN.

17. The Government Stock Farm, Valsayn, is part of the St. Augustine Estate which is rented by the Department of Agriculture. The farm has an area of 300 acres the greater part of which is in pasture, though maize and leguminous crops are cultivated as fodder for the stock. In addition to the animals maintained for stud purposes a herd of dairy cattle is kept for the supply of milk to the Colonial Hospital and other Government Institutions in Port-of-Spain. Bulls are also leased for use on the public pastures in Port-of-Spain and St. Augustine and elsewhere.

GOVERNMENT STOCK FARM, TOBAGO.

18. The Agricultural establishment in Tobago consists of a Stock Farm, Burleigh Castle, 219 acres in extent, and the Botanical Station at Scarborough. The Farm and Botanical Station are under a Manager, and there is a Farm Committee consisting of several prominent planters, with the Commissioner-Warden as Chairman, which advises as to the management of the Farm.

PUBLIC PASTURES.

19. The Government pastures at Port-of-Spain are in the charge of an officer called the Superintendent of Pastures for whom a salary of £50 is provided in the Estimates.

Provision is made for the custody of the pastures under a separate head of the estimates which includes expenditure on the hire from the Department of Agriculture of bulls for the service of cows belonging to the public which graze on the pastures.

The office of Superintendent of Pastures is held by the Warden of St. Ann's who does not necessarily possess any knowledge of either stock or agriculture.

Except that he has charge of the trees growing on them the Director of Agriculture is not concerned with the care and management of the public pastures.

GOVERNMENT VETERINARY SURGEON.

20. The Government Veterinary Surgeon receives a salary of £300 and an allowance of £100 as Superintendent of the Quarantine Station for Animals, and is entitled to private practice. He is required to attend Government animals of every description and his duties include the inspection of animals imported into the Colony, with a view to ascertaining that they are free from infectious or contagious diseases, and the control of preventive measures under the Contagious Diseases (Animals) Ordinance. The Veterinary Surgeon has no relations with the Department or Board of Agriculture. His functions are practically confined to the prevention of spread of disease; and little use is made of his knowledge and experience for the improving of the stock of the Colony.

FROGHOPPER INVESTIGATION.

21. By arrangement approved in Mr. Bonar Law's despatch No. 75 of February 12, 1916, an Entomologist was engaged for a period of two years to conduct a special investigation into the froghopper pest of the sugar cane.

Half the cost of this investigation is paid by the Government and half by the sugar planters. The Entomologist works under the control of a Committee composed of the Governor, the Director of Agriculture and a member of the planting community. During the past year investigations have been made by him in British Guiana, Venezuela, Central America and some of the West Indian Islands with a view to the discovery of an enemy of the froghopper, but no positive results have yet been obtained.

The two years engagement of the Entomologist employed on this work terminates on March 31, 1918.

AGRICULTURAL SOCIETY.

22. The Agricultural Society of Trinidad and Tobago was established in 1894, and is now incorporated under Ordinance No. 28 of 1906. Its objects are the dissemination of agricultural knowledge and the consideration, encouragement and advancement of all branches of agriculture in the colony. The Governor is ex-officio President of the

Society. The affairs and funds of the Society are administered by a Committee of which the Governor is Chairman. The Committee has power to make rules and regulations for the management of the Society including the conditions of membership and the appointment of members of the Committee. The Secretary is appointed by the President and may not be a member of the Society. The funds of the Society consist of subscriptions and fees of members and such annual grant as may be voted by the Legislative Council, but the law provides that the grant must not be less than £400.

Since 1895, the Society has received from Government an annual grant of £600. The amount raised by subscriptions of members is about £100 a year. The Society holds monthly meetings in Port-of-Spain at which matters of agricultural interest are discussed, and the greater part of its funds are expended in organising agricultural shows and exhibitions in Port-of-Spain and in the country districts, and in publishing a monthly journal which is supplied free to members. These shows are well attended and have done much to encourage improved methods of cultivation among peasant proprietors.

DISTRICT AGRICULTURAL SOCIETIES.

23. In connection with the Society, District Agricultural Societies have been established in several country districts. A District Society pays an annual affiliation subscription of 10/- to the parent Society, in return for which it is entitled to be represented by one of its members at any meeting of the parent Society, and its members also receive the Proceedings of the parent Society free of charge.

The Agricultural Society and the affiliated District Societies do much useful work in disseminating knowledge and stimulating interest in agricultural matters especially among the small proprietors.

AMALGAMATION OF STAFFS OF DEPARTMENT AND BOARD.

24. I now turn to proposals for re-organization. The most urgent need in any scheme of re-organization is the abolition of the present system of dual control and the unification of the separate staffs of the Department and Board of Agriculture. Such an amalgamation would not only result in greater efficiency by facilitating concentration of effort and eliminating the risk of rivalry, but it would also lead to economy of staff through the combination of the separate correspondence and accounts of the two organizations.

During the time it has been in existence the work of the Board of Agriculture has been of the greatest benefit to the agricultural interests of the Colony, and it is highly desirable that its usefulness should in no way be impaired.

To enable the Department of Agriculture to fulfil the purposes for which it was created it must possess the confidence of the agricultural and planting community. The Board of Agriculture has served to keep the Department in close touch with the needs of agriculture by giving the planters opportunities of expressing their views as to the work of the Department, and it is highly desirable that the Board should continue to perform this useful function.

25. To permit of the amalgamation of the staffs of the Department and Board it is, however, necessary that the Board should cease to be an executive body with a technical staff under its direct control. I propose that it should become an advisory and consultative body similar to the Boards of Agriculture in other Colonies. This change of status would be more apparent than real; for under existing conditions the executive work of the Board is practically in the hands of its Secretary and Chief Executive Officer who has to act on his own initiative or in consultation with the Chairman, the Governor, in regard to all matters in which immediate action is required, and to count upon obtaining the sanction of the Board at its next monthly meeting.

As mentioned in paragraph 8 of this despatch, when he drew up a scheme for the establishment of a Department of Agriculture, the original intention of Sir Henry Jackson was that the Board of Agriculture should be an advisory body; and experience of the past nine years tends to show that the departure from his scheme has not tended to efficiency. As has been explained above, the expenses of the Board of Agriculture are defrayed from an export tax on agricultural produce which was imposed on the suggestion of the members of the Agricultural Society. By reason of this self-imposed taxation the members of the Board have attached great importance to the retention of complete control over the expenditure of their funds: and so long as the Board is financed by means of this special agricultural tax, the members of the Board will probably be reluctant to surrender to Government the control over their expenditure.

ABOLITION OF AGRICULTURAL TAX.

26. In view of the fact that agriculture is the staple industry of the Colony on which the prosperity of practically every section of the population either directly or indirectly depends, it does not seem inequitable that the whole cost of the Department of Agriculture should be thrown upon the general revenue of the Colony. A complement to the proposal that the staff of the Board of Agriculture should be absorbed in that of the Department, must therefore be that the special agricultural tax should be abolished, and that the whole cost of the Department of Agriculture should be a charge against general revenue.

STAFF OF DEPARTMENT.

27. The Superior Staff of the Department now consists of the Director, who up to the present time has also been Government Analyst and Agricultural Chemist, and the Assistant Director, who is also Government Botanist and Superintendent of the Royal Botanic Gardens. The Superior Staff of the Board of Agriculture includes a Mycologist and Entomologist.

In consequence of the retention of the office of Government Analyst by Professor Carmody on his appointment to the post of Director of Agriculture, the whole of the analytical work connected with police, public health and customs matters has remained nominally under the Director of Agriculture. This arrangement is unsatisfactory and it is desirable that it should be determined. I propose that the work of

Agricultural Chemist should be performed by an officer of the Department of Agriculture and that the connection of the Government Analyst with the Department of Agriculture should cease. It will probably be convenient to place the Government Analyst under the control of the Medical Department, which is directly concerned with the administration of the Foods and Drugs Acts and other public health laws which provide most of the work of the Government Analyst and it may be found possible to effect some economy of staff by associating him with the Government Bacteriologist. When the staffs of the Department and Board are combined, the Superior Staff of the Department should include a Botanist, an Agricultural Chemist, an Entomologist and a Mycologist. There is no reason why any of these four technical posts should be specially associated with the offices of Director or Assistant Director of the Department as at present. It is desirable that these offices should be held by whichever of the four officers are considered most fitted for them.

It is not necessary at this stage to deal with the junior staff of the Department.

VETERINARY SURGEON.

28. When Sir Henry Jackson's proposals for the establishment of a Department of Agriculture were referred to the Imperial Commissioner of Agriculture, Sir Daniel Morris suggested that the Veterinary Officer should be included in the new Department. I concur in this recommendation and I consider that it is desirable that the Government Veterinary Surgeon should be a whole time officer whose services should be at all times available to advise stock owners as to the improvement of breeds and the prevention and treatment of disease. Owing to the terms of the appointment of the present holder of the office of Government Veterinary Surgeon, it is impossible to bring in this change until a vacancy occurs. I have, however, recently made the Government Veterinary Surgeon a member of the Board of Agriculture in order to bring him in touch with the Department of Agriculture and the members of the Board.

CENTRAL OFFICES FOR THE DEPARTMENT.

29. In view of the inconvenience and inadequacy of the office arrangements described in paragraph 8 above, the provision of a central office and laboratories for the Department is an urgent need. After careful consideration of the several alternative proposals, I have come to the conclusion that the most suitable place for the headquarters of the Department of Agriculture is the St. Clair Experimental Station, Port-of-Spain. It is important that the headquarters should be so situated as to be conveniently accessible to planters. For that reason the capital to which they all pay occasional visits to sell their produce and to purchase supplies has obvious advantages, while the nursery and experimental work carried on at St. Clair give that place advantages over other possible sites in Port-of-Spain.

I propose that the surplus balances of the St. Augustine and River Estates, amounting probably to about £9,000 should be assigned to the construction of suitable headquarters for the Department of Agriculture at St. Clair with accommodation for the combined staffs of the Department and the Board.

MANAGEMENT OF ST. AUGUSTINE AND RIVER ESTATES.

80. The management of the St. Augustine and River Estates by a Board is both cumbrous and dilatory. Decisions on matters of urgency have often either to be deferred until a meeting of the Committee can be convened or to be taken by the Chairman or by a member of the Committee in anticipation of the sanction of the Committee. It is desirable on the other hand that the planting community should be closely associated with the management of the estates, and this object could conveniently be attained if the functions of the Board of Management were advisory and consultative rather than executive and administrative.

I accordingly propose that the Board of Management as it now exists should be abolished, and that the St. Augustine and River Estates should be placed under the Director of Agriculture assisted by an Advisory Committee drawn from among the members of the Board of Agriculture.

ACCOUNTS OF ESTATES.

81. The arrangement under which the River and St. Augustine Estates are treated as separate business concerns seems to have little to commend it either from an administrative or an accounting point of view. The separation of the accounts of the estates from those of the Colony tends to weaken the control of Government and of the Legislative Council over expenditure. The argument used in favour of the present arrangement that a cocoa estate cannot be worked efficiently on an annual estimate like a Government Department is fallacious. In order to ensure economical working it is essential that the estimates of the annual revenue and expenditure on each branch of the work of the estate should be made, and in point of fact such estimates have been drawn up for both estates for the last six years, and all payments are made in same way as for departmental accounts.

As mentioned in paragraph 10 above the Committee of the Legislative Council appointed in 1913 to enquire into the management of the St. Augustine and River Estates expressed the opinion that there was no particular advantage in omitting the St. Augustine and River Estates from the annual estimates and consequently annual accounts of the Colony. I accordingly propose that the accounts of the Estates shall be included in the accounts of the Colony, annual estimates of the revenue and expenditure being framed in accordance with financial instructions.

DISPOSAL OF SURPLUS LANDS.

82. I have recently issued instructions that all the surplus lands of the St. Augustine Estate which are not required for public purposes should be disposed of, and I propose that the portions of the estate now leased to Government Departments should be transferred to the charge of the Department that uses them and the payment of rent discontinued. It will be remembered that 1,000 acres have recently been leased to Messrs. Nelson and Sons, and I have asked for your authority to utilise the Mount Hope Estate as a site for a new prison, but there remain

several hundred acres available for sale or lease. (1) When these surplus lands have been disposed of the management of the estate will be greatly simplified. It will perhaps be found convenient to put the land let under long lease in the custody of the Sub-Intendant of Crown Lands and to arrange for the payment of rents to be made to the Warden.

As regards the River Estate, practically the whole of the cultivable land is now used for experimental work in connection with the cultivation of cacao, coconuts, coffee, limes and other economic plants. The remainder of the area consists of poor land on the slopes of the hills, control over which it is desirable to retain for the conservation of the water supply of Port-of-Spain. This land is now being planted with trees suitable for shade and timber, so that ultimately some return will be obtained from it.

83. In the past, experimental work with practically every species of economic plant cultivated locally has been carried on at each of the estates, and also to some extent at St. Clair Experimental Station. There has in consequence been unnecessary duplication of work. Instructions have been issued that the River Estate should in future be used for experimental work on cacao, limes, coconuts, coffee and rubber, for which it is well suited, and that the St. Augustine Experimental plots should be devoted mainly to the cultivation of sugar, rice, cotton, bananas, corn, grasses and ground provisions, the existing rubber plantations being however retained. I propose that the St. Clair Experimental Station should continue to be used for nursery work in connection with cacao, coffee and other economic plants as well as for the cultivation of fruit and vegetables, and that the propagation of flowers and ornamental plants should be carried on at the Botanical Gardens at St. Ann's.

PUBLIC PASTURES.

84. I propose that the control of the public pastures, at any rate in Port-of-Spain, should be transferred to the charge of the Department of Agriculture, in order that supervision by technically qualified officers may be insured.

AGRICULTURAL SOCIETY.

85. Owing to its unofficial character the Agricultural Society is particularly useful to the small cultivators to whom its meetings afford opportunities to express their views, make complaints and to discuss freely the problems and difficulties that confront them. For this reason it is desirable that the unofficial status of the Society should be carefully preserved. I am doubtful, therefore, if it is expedient that the Governor should preside over the meetings of the Society. His presence must in some measure restrict the freedom of discussion, for he cannot be expected to acquiesce in hostile criticisms of Government officers or to defend before a semi-private body the policy of the Government. It is on the other hand desirable that such criticisms should not be suppressed. The Governor, as Chairman of the Board of Agriculture, which did not exist when the Agricultural Society was formed, has ample opportunities

(1) See Governor's despatch No. 367 of October 6, 1917.

of keeping himself in touch with the agricultural community, and I am inclined to think that the Agricultural Society would gain in freedom and independence if it became purely unofficial in character, the President and Vice-President being chosen by the Society from among its unofficial members, and the Governor ceasing to nominate two members of the Committee of Management, as he is now empowered to do under the rules of the Society. I propose, however, to await further experience of the working of the Society before taking steps to amend the law.

36. In conclusion it may be mentioned that in the report of the Education Commission (*vide* Council Paper No. 168 of 1916), referring to the question of agricultural education the Commission record their impression that agricultural education in primary schools as it exists to-day is little better than a sham. Certain recommendations for improvement are made the most important of which are that the services of the Agricultural Advisers should be utilised for instruction in primary schools, and that boys from secondary schools desirous of adopting practical agriculture as a career should be granted leaving exhibitions to enable them to undergo a course of instruction under the department of Agriculture. I hope that when the report of the Education Commission has been considered by the Legislative Council effect will be given to these valuable recommendations.

I have, &c.,

(Sgd.) J. R. CHANCELLOR,
Governor.

The Right Hon'ble
WALTER H. LONG, M.P.
&c., &c., &c.

TRINIDAD AND TOBAGO.

No. 29.—1918.

I ASSENT,

[L.S.]

J. R. CHANCELLOR,
Governor.

December 17, 1918.

AN ORDINANCE to provide for the establishment and organization of a Department of Agriculture.

[By Proclamation.](1)

BE it enacted by the Governor of Trinidad and Tobago with the advice and consent of the Legislative Council thereof as follows :

1. This Ordinance may be cited as the Department of Agriculture Ordinance, 1918.

2. In this Ordinance

“Director” means the Director of Agriculture ;

“Department” means the Department of Agriculture ;

“Board” means the Board of Agriculture established under this Ordinance.

1) The Ordinance came into effect by Proclamation on January 1, 1920.

3. There shall be a Department of Agriculture with a Director and such other officers as may be appointed by the Governor at such salaries as the Governor with the consent of the Legislative Council may from time to time direct.

4. The Director shall be responsible to the Governor for the administration and discipline of the Department.

5.—(1.) There shall be a Board to be called "The Board of Agriculture of Trinidad and Tobago" consisting of the Governor, the Director, and not less than twelve nor more than thirty persons to be appointed by the Governor and interested in the agricultural industries of the Colony.

(2.) In case of the absence on leave or through illness of any member of the Board the Governor may appoint any person similarly qualified to act in his stead.

(3.) Every member of the Board shall hold office for the term of four years from the date of his appointment.

(4.) The Governor shall be the President of the Board and the Director shall be the Vice-President.

(5.) Five members, including the Chairman, shall form a quorum.

(6.) On the commencement of this Ordinance the Board of Agriculture established under the Ordinance No. 35 of 1908 shall be dissolved.

6.—(1.) The Board shall be advisory and consultative and shall have no executive or administrative functions.

(2.) It shall be the duty of the Board to advise upon all questions connected with the agricultural interests of the Colony which may be referred to it by the Governor or the Director, and further it shall be competent for the Board to make recommendations to the Governor or the Director in connection with such questions without previous reference.

7. The Governor may make regulations for the conduct of the business and proceedings of the Board, for the organization of the Department, and generally for the effective carrying out of the purposes of this Ordinance.

Such regulations shall be laid before and be subject to the approval of the Legislative Council and shall be published in the *Royal Gazette*.

8. The Ordinances Nos. 35 of 1908, 16 of 1909, 2 of 1910 and 15 of 1911 are hereby repealed.

9. This Ordinance shall commence on a day to be fixed by the Governor by Proclamation.

Passed in Council this Sixth day of December, in the year of Our Lord one thousand nine hundred and eighteen.

J. M. FARFAN,
Acting Clerk of the Council.

THE DEVELOPMENT OF THE ECONOMIC RESOURCES OF THE EMPIRE.

Assistance for Scientific Research.

Despatch from the Secretary of State for the Colonies.

DOWNING STREET,
June 11, 1919.

SIR,

At the close of the prolonged struggle of the last four years, and having regard to the depletion of raw materials which has been caused and to the vast financial responsibilities which have been left behind, it is evidently more than ever necessary that the economic resources of the Empire in general should be developed to the uttermost, and I wish to suggest to you that the time is particularly opportune for a review of the activities carried on by or on behalf of your Government in scientific research and economic exploration, and for consideration of all promising schemes, either for new work of this description or for adding to the efficiency or widening the scope of work already in progress.

2. Apart from activities of a primarily scientific nature, such as research in oceanography and meteorology, the field to be reviewed may be very wide and should not be regarded as entirely economic in character. The main portion of the possible field of research may broadly be divided into enquiries relating to sources of mechanical power, agriculture and forestry, geology and minerals, and marine products. In most of these provinces the desirable enquiries may be classified, it is true, without any precise line of demarcation, into enquiries directed to an economic or other practical end which is in sight from the first, and enquiries where the practical aim, though real, is less immediately obvious. I am decidedly of opinion that the latter class of enquiries ought by no means to be neglected, and that if they are well chosen it may be expected that in the long run they will be even more fruitful in results of practical value than enquiries of the former class. The latter class of enquiry, however, demands a scientific staff with higher qualifications, and can scarcely be attacked effectually by a small Colony acting by itself. In such cases possible combination with other Colonies similarly situated should be considered.

8. It is becoming more and more clear that there is scarcely any industry which can develop or even maintain its position without the aid of scientific research, and that it is sound policy that such research should be liberally provided for in the budgets of the firms engaged, although it is frequently necessary that those firms should combine to finance a central research association, or at least closely co-operate in research work in order to cover the whole ground and avoid overlapping. With some assistance from the Imperial Treasury a good deal is being done in this country on these voluntary lines. There will no doubt be certain Colonial firms who can best participate by contributing to the research associations of their industries in this country. But the usual method in the Colonies is for research to be carried on by the scientific

departments of the Government, and financed out of the ordinary revenue and out of taxes on particular industries, while a subsidiary but important method is that of contribution to institutions for research and the like, usually situated for convenience in this country, some official, such as the Bureau of Entomology and the new Bureau of Mycology, and some unofficial, such as the research associations referred to above which are organised under the auspices of the Department of Scientific and Industrial Research.

4. Broadly, I would ask you to consider the position of any important industries in the Colony, on whose behalf no research work is at present carried on, and whether this state of affairs does not call for action on the part of the Colonial Government. I would particularly direct your attention to those raw materials required for Imperial trade or defence which are produced within the Empire either in inadequate quantities or not at all, such as flax, hemp, medium stapled cotton, the lighter timbers, ores of aluminium and copper, phosphate rock, potash and mineral oil. The question of the possible establishment or extension of fishing industries for export is also worth attention.

5. The Committee on Commercial and Industrial Policy after the War drew special attention to this question of raw materials in paragraph 122 of their final report [Cd. 9035]. Much of the existing deficiency can be supplied by the tropical Colonies and Protectorates if their great potential resources are adequately developed, and one of the most sure and speedy agents in such development is undoubtedly scientific investigation. The war has furnished a striking instance of the correctness of this view. One of the conspicuous examples of material produced to an insufficient extent within the Empire, to which the Committee called attention, was bauxite, the ore of aluminium. At the present time this country is almost entirely dependent on foreign sources of supply, and there is reason to apprehend that these will remain both costly and insufficient. Aluminium is essential to a number of British industries, and the position would be serious if alternative sources of supply had not been found within the Empire. The scientific investigations of the Director of the Geological survey of the Gold Coast have recently resulted in the discovery of a very large deposit of the mineral in that Colony, and it is hoped that arrangements can be made which will enable it to be worked on a paying basis. Valuable deposits of bauxite have also been found in British Guiana, and are now being developed. Other deposits in the same Colony are now under investigation. If these enterprises are successful, the position of the British industries in question will be greatly strengthened.

This is a solitary instance, but it is typical, and could, if necessary, be supported by others drawn from different parts of the Empire. There can indeed be no doubt that a sound and adequate scheme of scientific investigation would be of the utmost value in developing the resources of the Colonies.

6. Another example of the need of research is furnished by the destructive agencies of various kinds, such as animal and plant diseases,

insect pests, etc., which are responsible at the present time for an enormous amount of damage in the Colonies. Such damage can literally be assessed in millions of pounds. Valuable work in this sphere has already been done and continues to be done in many parts of the Empire, but there is undoubtedly great scope for extended research. Such work is likely to prove exceptionally fruitful, since many of these destructive agencies are widely distributed, and scientific discoveries which have been made in one Colony can often be utilised elsewhere. The scale on which this destruction takes place is well illustrated by a recent despatch from the Acting Governor of the East Africa Protectorate reporting that "more scientific and progressive methods must be adopted in dealing with stock diseases in native reserves if the future welfare of the stock industry is to be secured. It would be difficult to estimate the annual loss from the ravages of stock diseases in native reserves, but if it were placed at the low estimate of twelve per cent. it would easily represent a sum of approximately one million pounds per annum."

7. In Colonies and Protectorates whose financial resources are on a smaller scale than in the one under your government, there has hitherto often been great difficulty in finding the means to carry out investigations in themselves very desirable. I am glad to be able to inform you that, for the benefit mainly of such Colonies and Protectorates, I have obtained the consent of the Lords Commissioners of the Treasury to the provision of a liberal grant of £20,000 a year from the Estimates of the United Kingdom for 1919-20 and the four following years, to be expended in stimulating scientific research with a view to developing the economic resources of the Colonies and Protectorates. This grant, if it is duly voted, will be administered by a small Committee, to be known as the Colonial Research Committee, which will work in co-operation with the Department of Scientific and Industrial Research, the Imperial Mineral Resources Bureau, the Universities, particularly those of industrial districts, and other existing institutions. In the first instance the members of the Committee will be Mr. H. J. Mackinder, M.P. (Chairman), two Assistant Under Secretaries of State for the Colonies, and Sir Frank Hoath, the Secretary of the Department for Scientific and Industrial Research. The grant, liberal though it is, is evidently insufficient for a large number of researches, and the Committee will have to content itself with selecting for investigation a few of the most promising of the subjects which may be brought to its notice. It may sometimes be the case that a research may be required which would be chiefly in the collective interests of the Empire or in the interests of some part of it other than the part in which the research would be carried out. If it were convenient that such a research should be undertaken by a Colonial Government, the fact that that Government is prosperous would not debar it from participating in the grant.

8. To the whole question of research and investigation raised by this despatch I attach the greatest possible importance, and I trust that you will give it your personal consideration, in consultation with your scientific and economic officers, and with suitable members of the unofficial community, and that you will then furnish me with a brief

review of the present position of affairs, and with an account of the further steps which in your judgment should be taken in the near future.

I have, etc.

MILNER.

The Officer Administering
the Government of Trinidad and Tobago.

The despatch was submitted to the Board of Agriculture, a Committee appointed, whose report, subsequently adopted by the Board follows:—

ECONOMIC RESOURCES OF THE EMPIRE.

ASSISTANCE FOR AGRICULTURAL SCIENTIFIC RESEARCH.

REPORT OF COMMITTEE.

THE Committee of the Board of Agriculture, consisting of Mr. W. G. Freeman, B.Sc., Acting Director of Agriculture (Chairman), Messrs. C. Forbes-Todd, Wm. Greig, W. S. E. Barnardo, W. C. Jardine and C. S. Rogers, (Conservator of Forests); makes the following recommendations:—

Trinidad and Tobago, in common with all the other British West Indian Colonies, are mainly dependent on agriculture for their economic welfare.

In tropical agriculture there is a great field for continuous research work, with both immediately practical problems and others which may lead to practical developments. A large amount of useful research work has been and is being carried out chiefly by officers of Government Agricultural Departments, but progress is necessarily retarded owing to most of the officers having also administrative duties. Scientists visiting the West Indies, or otherwise taking a special interest in the work, often express surprise that so much has been accomplished in spite of this obvious heavy handicap. It is an urgent necessity that this condition of affairs should be improved, and that additional resources in men and money should be available for the prosecution of research work of vital importance to the West Indies and to the Empire as a whole.

It is difficult, however, to provide these funds locally, and in the West Indies there are no universities or other endowed seats of learning to assist in research as in the United Kingdom. The chief agricultural products, including in this term timber and stock, are sugar, cacao, fruits (bananas, citrus, &c.), coconuts and copra, lime juice, cotton, coffee, rice, spices (nutmegs, &c.), tobacco, timber and stock.

The conditions under which they are produced and also their diseases and pests are more or less similar throughout the West Indies, and many of the problems awaiting investigation would, when solved, bear results of practical importance to several of the Colonies. For these reasons one central research Institute would be the most economical and efficient means of providing for the agricultural development of these colonies, and Trinidad appears to possess advantages and facilities

which indicate it as a site of such a central institution. In the days before the war, the whole British West Indies (British Guiana, Trinidad and Tobago, Windward Islands, Leeward Islands and Jamaica) exported agricultural products to the value of about £11,762,000 of which over one quarter of the whole came from Trinidad and Tobago. More recent figures for all the colonies are not immediately available, but the proportion is probably substantially the same now. Trinidad and Tobago also produce on a commercial scale a much larger variety of the chief West Indian products than any other West Indian Colony. In 1918 the value of the chief products were:—

Sugar and products	...	...	...	£1,547,085
Cacao ...	...	...	...	1,014,981
Coconuts, copra, &c.	...	...	...	224,099
Rubber	...	...	...	4,989
Limes and products	...	...	...	9,541
Grain, pulses, &c....	...	...	...	1,813
Fruit ...	...	...	...	986
Miscellaneous, Coffee, spices, cotton, &c....	...	...	...	935
Forest products, timber, balata	...	...	...	1,017
Live stock and skins	...	...	...	31,041
				£2,835,937

Other advantages possessed by the colony for the prosecution of research work are the existence of Botanic Gardens and Experiment Stations, Stock Farms, River (Cacao) Estate, St. Augustine Estate (Sugar), &c., all forming part of the equipment of the Department of Agriculture. In these, with the additional assistance already referred to increased research activity could more easily be developed than by the establishment of entirely new centres.

The Colony is also the only one in the West Indies in which there is already a trained Forest Officer, who has under his care large areas of Government Forest Reserves and Plantations.

The geographical position of the colony is convenient, and it is free from hurricanes and serious earthquakes.

For these reasons the Committee recommends that a Central Agricultural Research Institute for the West Indies is the most urgent necessity, and that Trinidad offers the most favourable site. And in view of the important results which would doubtless follow from increased activity in scientific research, to so many agricultural industries of importance to the whole of the British West Indies, that a grant of £5,000 a year would be well spent.

W. G. FREEMAN,
Chairman.

October 16, 1919.

METEOROLOGY.

RAINFALL RETURNS.—OCT. TO DEC., 1919.

Stations.	October.	November.	December.	January to Dec., 1919.	January to Dec., 1918.
<i>North-west District.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>
St. Clair—Royal Botanic Gardens ...	7.79	8.42	6.07	57.18	63.03
Port-of-Spain—Colonial Hospital ...	7.45	7.11	...	49.78	...
" Royal Gaol... ..	8.04	7.22	6.26	55.80	56.03
" Constabulary Headquarters ...	7.31	6.38	3.35	47.67	40.76
St. Ann's—Reservoir	9.32	8.62	5.84	64.29	82.69
Maraval—	6.74	5.69	5.06	52.81	76.97
" Constabulary Station	8.74	5.99	5.17	62.00	81.27
Diego Martin—Constabulary Station ...	9.06	7.94	5.32	71.93	80.79
" Waterworks	8.41	6.67	4.89	60.55	72.71
" River estate	8.73	6.30	6.10	61.33	71.97
Fort George Signal Station	7.02	6.90	10.31	61.99	67.83
North Post	3.91	5.08	5.17	47.70	67.83
Carenage Constabulary Station	8.45	7.93	10.55	60.50	76.30
Carrera Island Convict Depôt	2.96	...	2.72	...	21.06
Chacachacare Lighthouse	3.14	4.88	4.63	44.39	53.06
<i>Santa Cruz—Maracas District.</i>					
Santa Cruz—Constabulary Station	9.47	8.71	1.39	65.90	84.36
St. Joseph—Government Farm	3.11	9.76	3.18	53.24	60.81
" Constabulary Station	3.43	8.72	2.94	11.73	17.51
Tunapuna—St. Augustine estate	1.31	8.78	3.16	19.99	56.76
Maracas—Government School	9.42	8.19	5.50	61.47	...
" Ortínola estate	5.51	8.16	4.86	53.56	73.13
" San José estate	6.25	9.00	5.17	59.15	69.89
Oaura—Wardour estate	5.50	7.78	4.08	50.57	61.42
<i>West Central District.</i>					
Caroni—Frederick estate	5.42	8.00	3.99	62.95	68.18
Chaguanas—Constabulary Station	6.28	8.02	5.19	55.58	55.15
" Woodford Lodge estate	6.18	8.52	5.44	51.21	56.39
Carapichaima—Waterloo estate	8.10	7.02	6.60	64.81	68.07
" McBean Cacao estate	7.54	7.31	6.48	58.85	63.33
" Friendship Hall estate	5.89	7.50	5.39	56.46	...
Couva—Exchange estate	8.20	1.92	...	...	...
" Brechin Castle estate	8.99	9.36	6.02	65.21	60.00
" Perseverance	8.50	7.22	4.82	52.97	...
" Camden	6.32	...	4.71	...	...
" Milton	7.77	7.53	6.18	64.85	61.00
" Spring	6.80	6.22	4.78	55.85	62.01
" Constabulary Station	6.08	7.84	5.32	60.86	50.31
" Esperanza estate	6.69	8.85	4.15	50.10	50.70
<i>Montserrat District.</i>					
Brasso-Piedra—Mamoral estate	4.18	12.00	9.94	83.24	87.11
" La Mariana estate	5.69	13.42	8.86	82.39	83.83
Montserrat—Constabulary Station	3.95	7.31	6.62	60.62	65.23
Brasso—La Vega estate	6.69	12.29	7.97	78.08	81.37
Tabaquite, Trelawne estate ... ..	...	9.62	7.97	...	...
<i>Arima District.</i>					
Arima—Warden's Office	3.30	10.84	6.25	66.78	80.08
" Torrecilla estate	4.85	11.89	7.32	81.53	92.11
" Verdant Vale estate	6.59	12.34	6.14	80.58	70.66
San Rafael—Constabulary Station	7.08	10.87	6.27	83.83	91.64
Guanapo—Talparo estate	5.23	9.64	7.59	77.13	85.34
" El Quemado estate	8.22	10.75	12.18	90.86	100.67
Tamana—Sta. Marta estate	8.01	12.17	18.71	110.18	106.45
" La Carona estate	8.76	15.49	12.38	100.07	99.60
<i>San Fernando & Princes Town District.</i>					
Claxton's Bay—Forres Park estate	4.61	5.90	...	...	53.73
Pointe-à-Pierre—Bonne Adventure estate	3.33	8.21	4.61	45.67	63.84
" Concord estate	5.20	6.34	4.43	44.91	65.09
" Plein Palais estate	5.60	7.25	4.30	47.93	50.90
Naparima—Picton estate	3.86	5.68	6.48	57.02	65.44
" Usine St. Madeleine estate ...	4.95	7.35	6.72	53.79	58.08
" La Fortunée estate	6.86	4.43	4.87	44.82	51.35
" Tarouba estate	3.13	6.13	3.84	42.40	46.88

RAINFALL RETURN—OCT. TO DEC., 1919.—CONTINUED.

Stations.	October.	November.	December.	January to Dec., 1919.	January to Dec., 1918.
<i>San Fernando and Princes Town District.—(Contd.)</i>					
Naparima—Palmiste estate ...	4.62	6.24	7.70	60.90	61.95
„ Lewisville House ...	5.50	8.36	6.04	61.31	70.35
„ Hermitage estate ...	4.19	4.69	5.51	59.78	60.56
„ Petit Morne estate ...	4.94	8.01	...	...	...
Princes Town—Craignish estate ...	3.51	8.53	7.93	59.48	81.31
„ Cedar Hill estate ...	4.79	7.01	6.59	58.18	70.57
„ Williamsville estate ...	5.08	6.68	...	...	71.89
„ Esmeralda estate ...	5.32	9.26	6.86	81.68	82.15
„ New Grant estate ...	4.96	9.43	8.56	64.14	84.42
„ Constabulary Station ...	4.35	7.46	5.49	47.99	57.71
„ Hindustan estate ...	4.40	8.12	7.41	55.51	71.25
„ La Retraite estate ...	6.75	11.06	10.34	83.46	103.16
„ Malgretoute estate ...	5.42	7.56	6.96	53.19	82.18
Friendship & Bon Lomond estates ...	...	...	...	...	...
Los Naranjos estate ...	4.16	8.24	...	...	75.60
Poole—El Rosario estate ...	5.45	7.33	7.19	67.21	100.02
<i>South-west District.</i>					
Oropuche—Constabulary Station ...	3.16	2.76	2.80	24.32	71.41
„ Pluck estate ...	4.98	6.38	...	...	65.38
Siparia—Constabulary Station ...	7.95	8.56	5.69	52.20	77.95
„ Alta Gracia estate ...	8.13	8.53	6.78	64.88	81.39
Guapo—Adventure estate ...	6.39	7.88	5.52	47.81	67.30
Point Fortin—Constabulary Station ...	6.63	7.96	5.91	62.19	79.58
Erin—La Resource estate ...	6.14	5.88	...	...	47.70
La Union estate ...	4.12	7.09	6.65	19.82	55.32
Industry estate ...	3.58	6.80	6.77	49.49	61.24
Cedros—La Retraite estate ...	7.11	7.79	6.10	66.76	77.70
„ Beaulieu estate ...	3.34	5.94	7.30	48.65	...
„ Perseverance estate ...	6.51	4.86	7.14	52.06	52.34
„ St. Marie estate ...	6.00	5.29	5.60	53.41	56.89
„ Constabulary Station ...	6.33	5.68	8.27	56.01	55.45
„ St. Quintin estate ...	4.96	4.29	8.15	52.96	50.01
Icacos—Constance estate ...	3.44	2.35	7.51	...	110.75
Irois—Government School ...	6.10	8.66	4.23	61.40	73.03
<i>South Coast.</i>					
Moruga—Constabulary Station ...	5.53	6.29	6.29	61.25	60.18
<i>East Coast.</i>					
Matura—La Juanita estate ...	9.20	13.70	9.01	97.61	106.51
Manzanilla—Constabulary Station ...	8.08	14.52	5.80	85.81	93.61
„ Indravan estate ...	...	...	...	...	97.52
Sangre Grande—New Lands estate ...	8.59	16.28	...	...	111.64
„ Evasdale estate ...	7.92	13.45	10.51	97.24	105.33
„ Grosvenor estate ...	8.96	12.85	9.06	98.57	108.95
„ El Recoondo estate ...	8.06	13.40	9.00	89.88	91.65
„ San Francisco estate ...	12.05	15.72	11.87	109.71	97.39
Mayaro—Constabulary Station ...	7.39	12.13	7.51	68.79	82.19
<i>North Coast.</i>					
Blanchisseuse—Constabulary Station ...	4.37	11.15	8.05	70.84	87.50
Grande Rivière—Mon Plaisir estate ...	12.93	17.65	9.31	110.00	113.38
Toco—Aragua House ...	8.88	13.23	5.68	81.10	82.47
„ Constabulary Station ...	9.26	12.07	6.44	69.14	73.15
Point Galera—Light House ...	...	...	...	...	61.07
<i>Tobago.</i>					
Tobago—Hermitage estate ...	9.41	16.17	7.82	98.54	...
„ King's Bay „ ...	6.07	10.83	5.49	76.31	80.37
„ Roxburgh „ ...	7.47	11.31	7.08	84.20	...
„ Lure estate ...	...	...	...	...	120.29
„ Botanic Station ...	6.17	7.38	6.03	61.14	65.52
„ Government Farm ...	5.06	8.21	4.08	50.36	46.92
„ Lowlands estate ...	...	...	...	...	...
„ Friendship „ ...	3.60	8.03	4.18	...	59.18
„ Riversdale „ ...	...	...	...	...	67.39
„ Bon Accord „ ...	2.84	8.09	...	...	...

